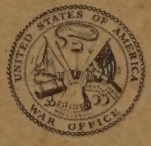
# TM 9-6067

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ORDNANCE MAINTENANCE

# RANGE FINDERS M12 AND T41

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TECHNICAL MANUAL
No. 9–6067

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *14 December 1954*

# ORDNANCE MAINTENANCE:

# RANGE FINDERS M12 AND T41


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# CHAPTER 1

# INTRODUCTION

## Section I. GENERAL

### 1. Scope

*a.* These instructions are published for the information and guidance of personnel responsible for field and depot maintenance of range finders M12 and T41. This manual does not contain information which is intended primarily for the using organization, since such information is available to ordnance maintenance personnel in the pertinent operator's technical manual or field manual.

*b.* This manual contains a description of and procedures for inspection, disassembly, repair and rebuild, and assembly of the range finders M12 and T41.

*c.* The appendix contains a list of current references, including supply manuals, technical manuals, and other available publications applicable to the materiel.

*d.* Operation, lubrication, and all maintenance operations allocated to using organizations in performing maintenance work within their scope for the range finders M12 and T41 are contained in TM 9–718A.

*e.* This first edition is being published in advance of complete technical review of all concerned. Any errors or omissions will be brought to the attention of Chief of Ordnance, Washington 25, D. C., ATTENTION: ORDFM-Pub.

### 2. Field and Depot Maintenance Allocation

The publication of instructions for complete disassembly and rebuild is not to be construed as authority for the performance by field maintenance units of those functions which are restricted to depots and arsenals. In general, the prescribed maintenance responsibilities will apply as reflected in the allocation of maintenance parts listed in the appropriate columns of Department of the Army Supply Manual ORD 8 SNL F–356, Section 1, and tools which are listed in ORD 6 SNL J–32. Instructions for depot maintenance are to be used by maintenance companies in the field only when the tactical situation makes the repair functions imperative. Provisions of parts listed in the depot stock guide column of ORD 8 SNL F–356, Section 1, will

be made to field maintenance only when the emergency nature of the maintenance to be performed has been certified by a responsible officer of the requisitioning organization.

### 3. Forms, Records, and Reports

*a. General.* Responsibility for the proper execution of forms, records, and reports rests upon the officers of all units maintaining this equipment. However, the value of accurate records must be fully appreciated by all persons responsible for their compilation, maintenance, and use. Records, reports, and authorized forms are normally utilized to indicate the type, quantity and condition of materiel to be inspected, to be repaired, or to be used in repair. Properly executed forms convey authorization and serve as records for repair or replacement of materiel in the hands of troops and for delivery of materiel requiring further repair to ordnance shops in arsenals, depots, etc. The forms, records, and reports establish the work required, the progress of the work within the shops, and the status of the materiel upon completion of its repair.

*b. Authorized Forms.* The forms generally applicable to units maintaining this materiel are listed in the appendix. No forms other than those approved for the Department of the Army will be used. Pending availability of all forms listed, old forms may be used. For a current and complete listing of all forms, refer to SR 310–20–6. For instructions on the use of these forms, refer to FM 9–10. Additional forms applicable to the using personnel are listed in the operator's manual.

*c. Field Reports of Accidents.* The reports necessary to comply with the requirements of the Army safety program are prescribed in detail in the SR 385–10–40 series of special regulations. These reports are required whenever accidents involving injury to personnel or damage to materiel occur.

*d. Report of Unsatisfactory Equipment or Materials.* Any suggestions for improvement in design and maintenance of equipment and spare parts, safety and efficiency of operation, or pertaining to the application of prescribed lubricants, and/or preserving materials, or technical inaccuracies noted in Department of the Army publications, will be reported through technical channels, as prescribed in SR 700–45–5, to the Chief of Ordnance, Washington 25, D. C., ATTN: ORDFM, using DA Form 468, Unsatisfactory Equipment Report. Such suggestions are encouraged so that other organizations may benefit.

*Note.*—Do not report all failures that occur. Report only REPEATED or RECURRENT failures which indicate unsatisfactory design or material. See also SR 700–45–5 and the printed instructions on DA Form 468.

## Section II. DESCRIPTION AND DATA

### 4. Description

*a.* The range finders M12 and T41 (figs. 1 and 2) function as the primary ranging and sighting equipment for the 90-mm gun and the coaxial 50 caliber machine gun in the 90-mm gun tank M47. It is essentially a stereoscopic, ballistic-computing range finder operated by the gunner who, through use of the various adjustment knobs, indexes the proper ammunition, sets the ballistic correction, ranges and tracks the target, and bore sights the gun for firing. The weapons can be fired against fixed or moving ground targets from the stationary tank. The range finder is supported by two main bearing assemblies attached to the tank turret roof. The range finder is connected, through connectors and rods, to the ballistic drive and the gun trunnion.

*b.* The range finder consists essentially of two end housing assemblies (figs. 1 and 2), a telescope assembly, a compensator assembly, a collimator assembly, a ballistic cam housing assembly, and the main housing which contains gearing, wiring, and other associated parts. The end housing assemblies reflect the line of sight from the target into the telescope assembly. The line of sight continues into the main housing through the telescope assembly for viewing through the eyepiece assembly. The compensator assembly is used to obtain stereo contact between the stereo reticle and the target. The collimator assembly receives the projected images of the various scales and reticles for viewing through the eyepiece assembly. The ballistic cam housing assembly is attached to the left side of the main housing and is used to introduce superelevation to the gun.

### 5. Functional Description

*a. End Housing Assemblies.* The windows (figs. 3 and 4) in the two end housing assemblies function to receive the light rays forming the target image and also prevent dust and dirt from collecting in the housings. The direction of the optical axis is changed 90° by the penta reflectors to direct the left and right lines of sight into the main housing. An adjustable optical wedge corrects for horizontal (azimuth) deviation which permits the interchangeability of end housing assemblies. The wedge also seals this end of the housing against dirt and dust.

*b. Bearing Assemblies.* The suspension of the range finder by the two bearings allows rotary motion to the range finder about an axis perpendicular to the gun tube. Linkages connecting the range finder and gun function to maintain the line of sight of the range finder in correct relation to the gun. When the range finder is not installed in the tank, a pawl locks the right bearing to the main housing, pro-

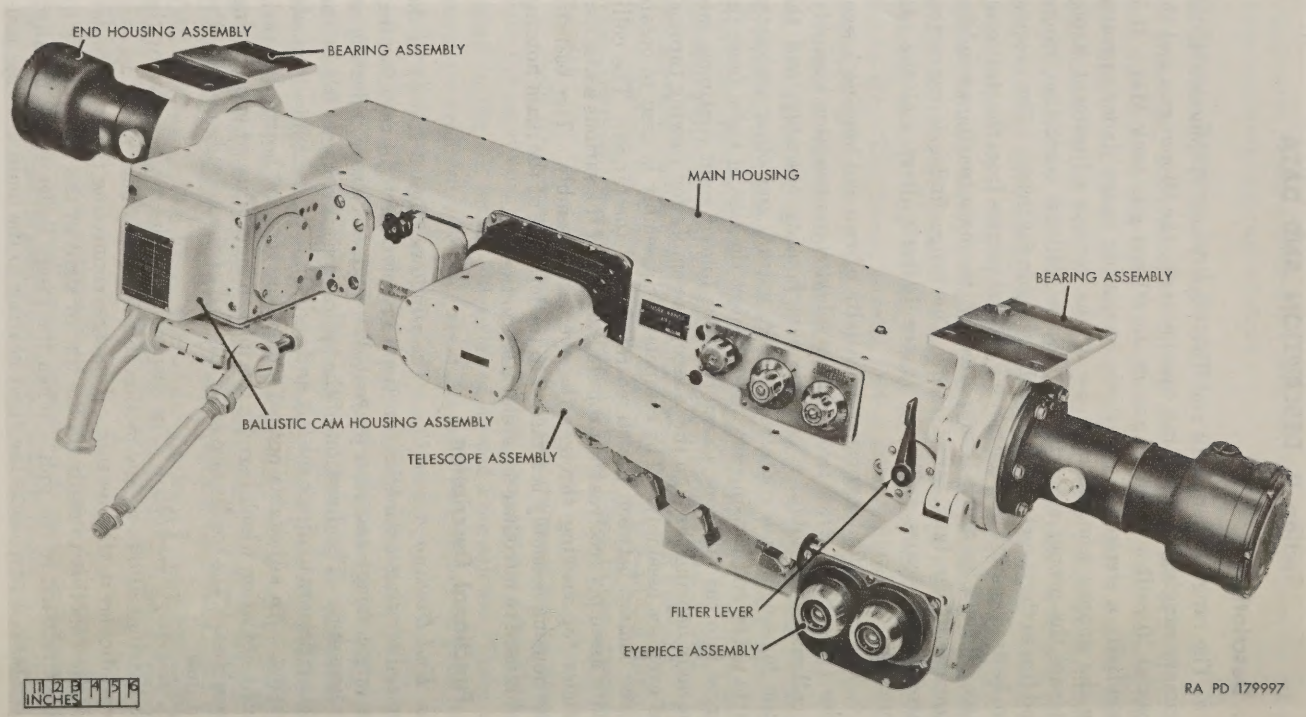



*Figure 1. Range finder M12.*

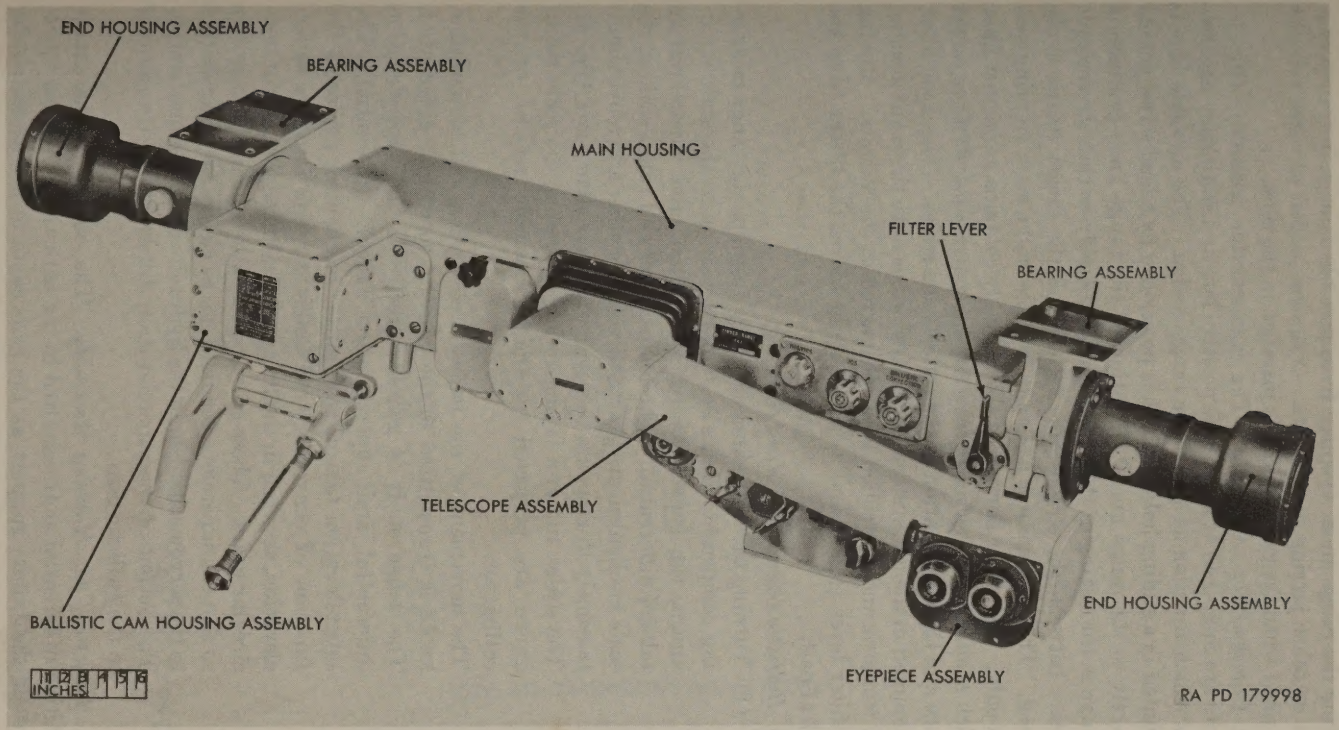



*Figure 2. Range finder T41.*

tecting the range finder eyepiece from possible damage in transportation or other jarring movements. A spring-loaded plunger releases the pawl when the range finder is installed in the tank.

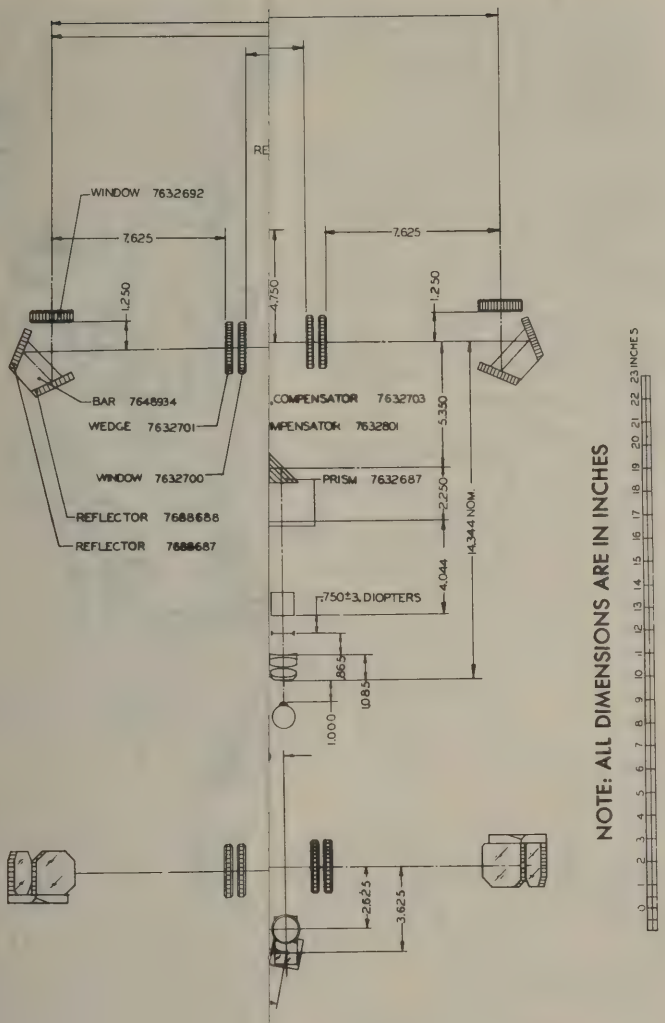
*c. Compensator Assembly.* The compensator assembly (fig. 5) optics are composed of a movable positive lens and stationary negative lens which function as a variable range wedge. The movable lens is mounted in a sliding holder which is positioned by a lead screw geared directly to the range knob. Rotation of the range knob produces a change in the setting of the compensator assembly so that stereoscopic contact between the stereoscopic reticle and the target image is obtained. The compensator assembly is in the right main sighting system only. The filter portion of the assembly contains a contrast filter which enables the observer to increase the contrast between the target image and the illumination of the reticles and scales. The same filter is mounted in the left system, both being adjacent to the main housing end windows and controlled by a rod geared to the mounts. Moving the filter lever (figs. 1 and 2) to the right moves the filters from the optical path.

*d. Ballistic Gearing of Main Housing.*

(1) Turning the range knob not only positions the range measuring compensator but also imparts motion to the scale mechanism, the superelevation differential, and superelevation takeoff differential. The compensator and range scale of the scale mechanism are geared directly together and move simultaneously in response to a pair of noncircular gears (fig. 6). The scales and gun laying reticle images of the scale mechanism are projected on the stereoscopic reticles of the collimator.

(2) The movement of the ballestic correction and ammunition knobs is transmitted to the ballistic correction differential. The range shaft is geared directly to the superelevation differential and superelevation takeoff differential. The superelevation takeoff transmitter mechanism performs the function of converting the ballistic range into the superelevation, as given in the firing tables, through a pair of noncircular gears. These gears position the synchro transmitter so that the superelevation data can be electrically transmitted to the servomechanism in the hydraulic elevating mechanism. The output of the superelevation differential is transmitted to the ballistic cam.

*e. Ballistic Cam Housing Assembly.* The output of the superelevation differential as transmitted to the ballistic cam causes movement of the bronze support as the cam contacts the diametrically


WINDOW 7632692
7.625
7.625
1.250
4.750
1.250
BAR 7648934
WEDGE 7632701
COMPENSATOR 7632703
COMPENSATOR 7632801
5.350
WINDOW 7632700
PRISM 7632687
2.250
14.344 NOM.
REFLECTOR 7688688
REFLECTOR 7688687
4.044
750±3, DIOPTERS
.865
.085
1.000
2.625
3.625
NOTE: ALL DIMENSIONS ARE IN INCHES
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 INCHES

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tecting the range finder eyepiece from possible damage in transportation or other jarring movements. A spring-loaded plunger releases the pawl when the range finder is installed in the tank.

*c. Compensator Assembly.* The compensator assembly (fig. 5) optics are composed of a movable positive lens and stationary negative lens which function as a variable range wedge. The movable lens is mounted in a sliding holder which is positioned by a lead screw geared directly to the range knob. Rotation of the range knob produces a change in the setting of the compensator assembly so that stereoscopic contact between the stereoscopic reticle and the target image is obtained. The compensator assembly is in the right main sighting system only. The filter portion of the assembly contains a contrast filter which enables the observer to increase the contrast between the target image and the illumination of the reticles and scales. The same filter is mounted in the left system, both being adjacent to the main housing end windows and controlled by a rod geared to the mounts. Moving the filter lever (figs. 1 and 2) to the right moves the filters from the optical path.

*d. Ballistic Gearing of Main Housing.*

(1) Turning the range knob not only positions the range measuring compensator but also imparts motion to the scale mechanism, the superelevation differential, and superelevation takeoff differential. The compensator and range scale of the scale mechanism are geared directly together and move simultaneously in response to a pair of noncircular gears (fig. 6). The scales and gun laying reticle images of the scale mechanism are projected on the stereoscopic reticles of the collimator.

(2) The movement of the ballestic correction and ammunition knobs is transmitted to the ballistic correction differential. The range shaft is geared directly to the superelevation differential and superelevation takeoff differential. The superelevation takeoff transmitter mechanism performs the function of converting the ballistic range into the superelevation, as given in the firing tables, through a pair of noncircular gears. These gears position the synchro transmitter so that the superelevation data can be electrically transmitted to the servomechanism in the hydraulic elevating mechanism. The output of the superelevation differential is transmitted to the ballistic cam.

*e. Ballistic Cam Housing Assembly.* The output of the superelevation differential as transmitted to the ballistic cam causes movement of the bronze support as the cam contacts the diametrically

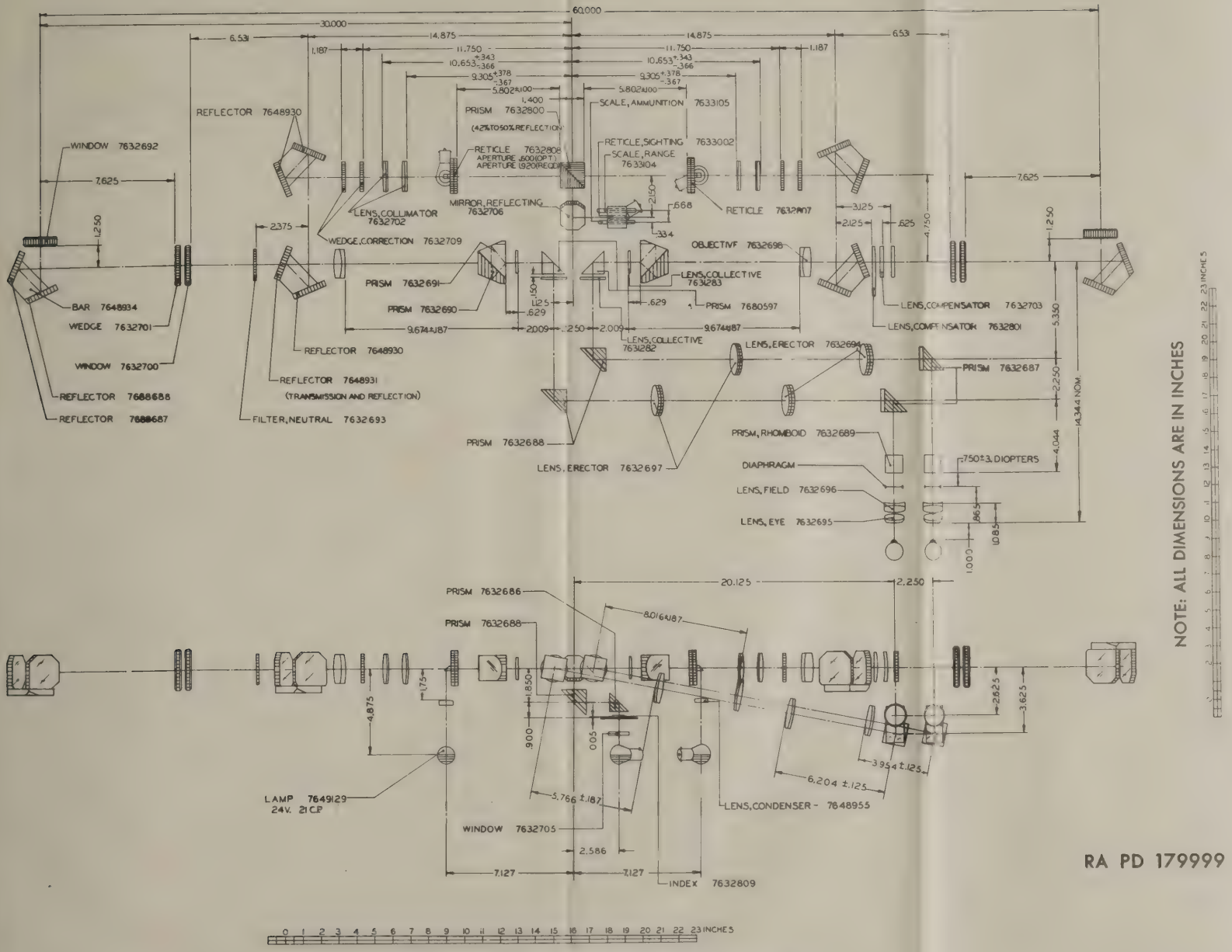



*Figure 8. Optical system for range finders M12 and T41.*

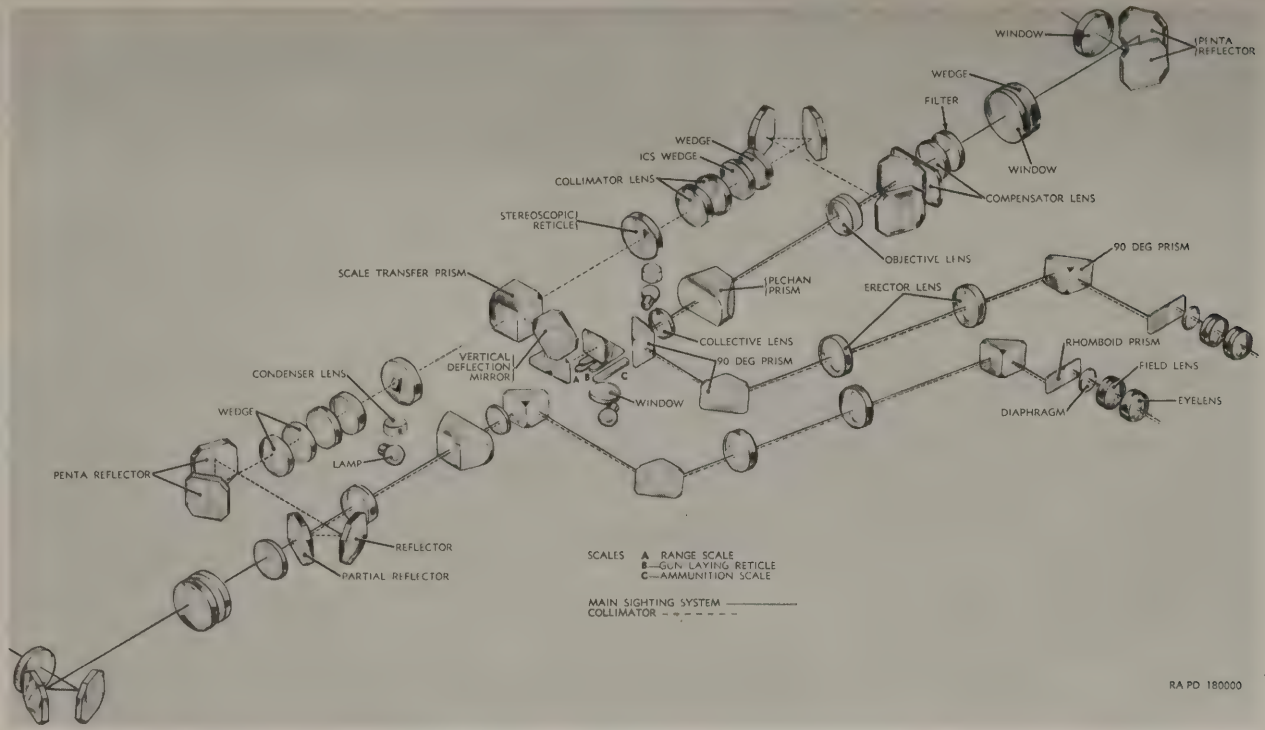



*Figure 4. Optical system for range finders M12 and T41.*

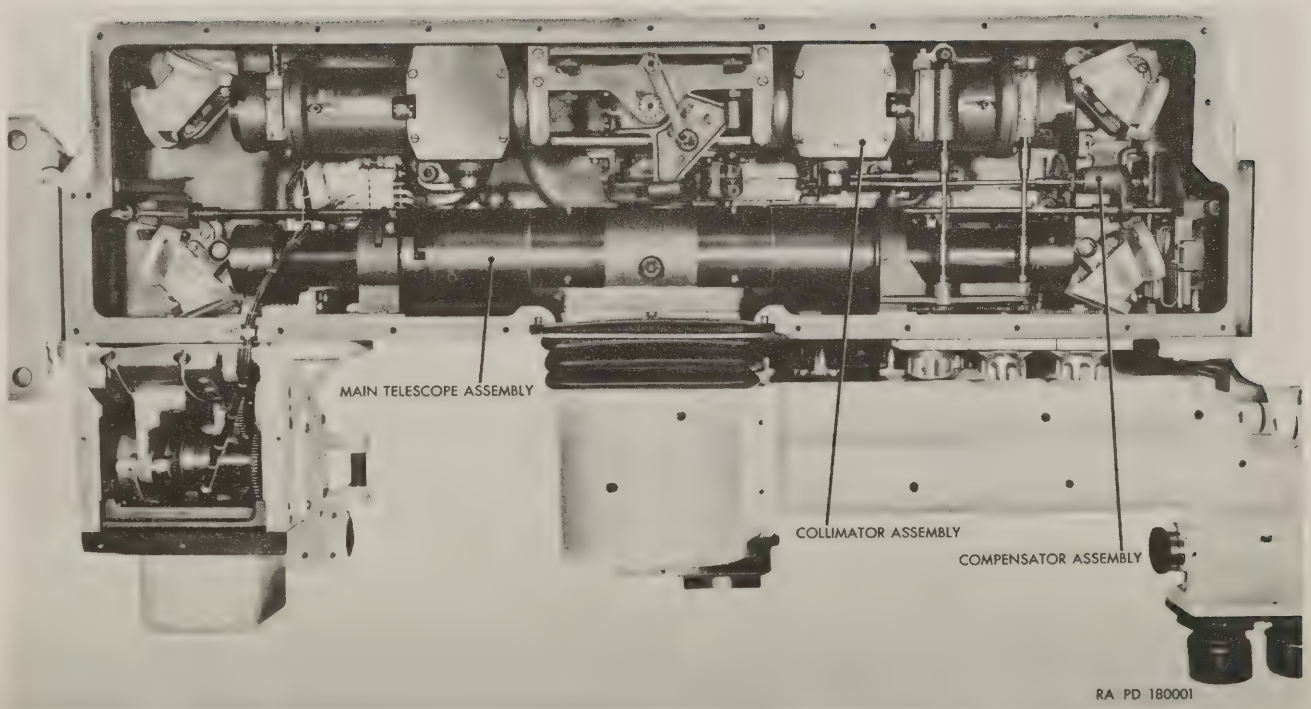



*Figure 5. Internal view of range finder M12.*

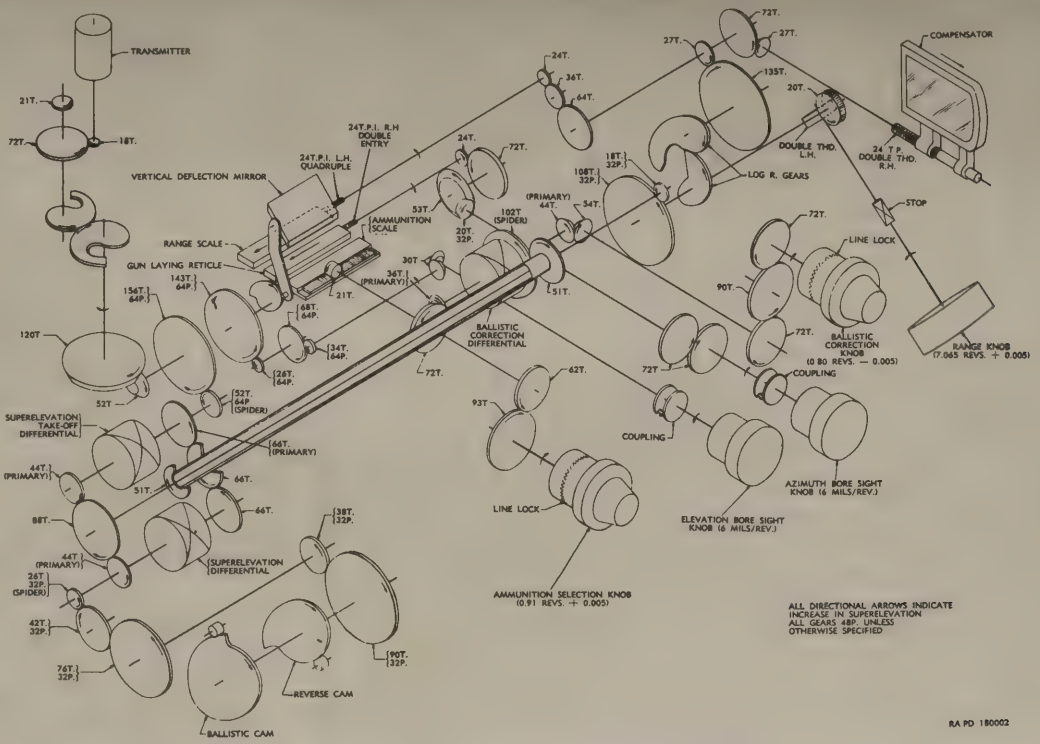



*Figure 6. Ballistic gearing schematic (T41).*

opposed cam followers fixed to the bronze support. Since the direction of movement of the bronze support is controlled by the center race of the three-race bearing to which it is fixed, the parallel linkage to the gun is affected. As a result, superelevation is introduced into the range finder by the rotation of the ballistic cam, causing the line of sight of the range finder to raise or lower in proportion to the cam lift.

*f. Collimator Assembly.* The collimator assembly (fig. 5) receives the projected illuminated images of the range and ammunition scales, and gun laying reticles from the scales. For normal ranging, the axis is deflected 90° by the scale transfer prism through the left side of the collimator into the main telescope for viewing by the left eyepiece. The stereoscopic reticles are viewed through both eyepieces.

*g. Telescope Assembly.* The telescope assembly extends the line of sight from the end housings. The scales and reticles are deflected 90° by the penta reflectors so that they are superimposed on the target image as viewed through the telescope assembly. Since the optical tube of the telescope is supported on ball bearings, the main housing will rotate while the telescope assembly remains fixed. As a result, the eyepieces are held fixed with respect to the tank gun turret when the gun and range finder are elevated or depressed.

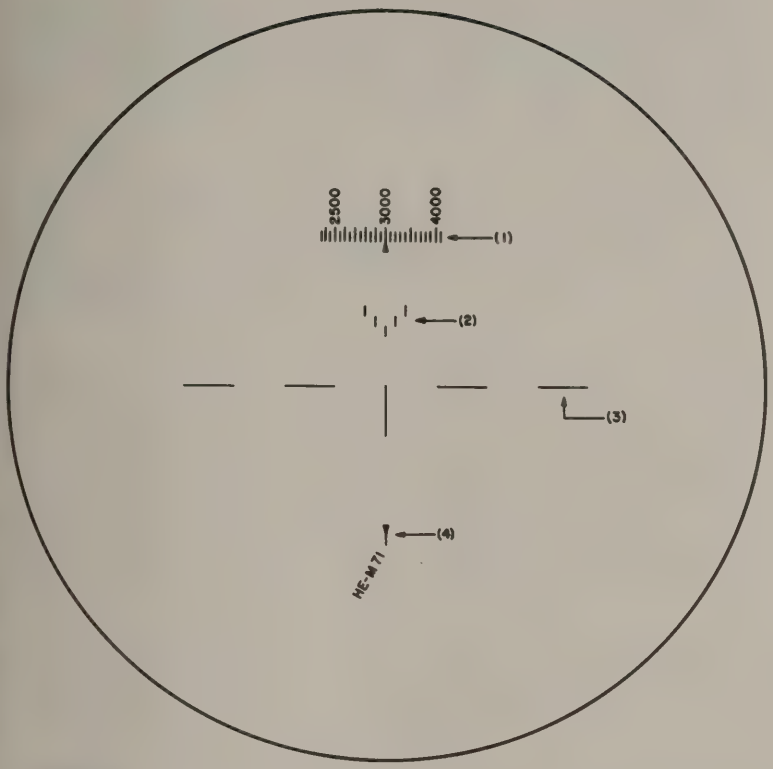
*h. Reticle Patterns.* The range, ammunition, azimuth, and elevation knobs position the scales and reticle patterns (fig. 7) for proper viewing through the telescope assembly. The range, ammunition, and ballistic knobs are used to correct for the effect of gravity, for ambient ballistic conditions (muzzle velocity, air density, wind, and atmospheric temperature) and ammunition characteristics.

## 6. Differences Between Models

*a.* The difference between the range finder M12 (fig. 1) and the T41 (fig. 2) is in the geared relationship of the superelevation synchro to the rest of the gear chain in the range finder.

*b.* The major mechanical differences involve the transfer of the superelevation mechanism assembly from the main housing to the ballistic cam housing and the addition of a segment gear to the ballistic cam housing assembly. This gear functions to convey the superelevation impulse as interpreted by the ballistic cam to the superelevation mechanism.

*c.* The exterior appearance of the cam housing for range finder M12 is changed by the substitution of a bulged ballistic cam housing cover (fig. 1) which is necessary to provide space for the addition of the superelevation mechanism assembly. Also, the ammo data chart for the T41 differs from the M12 chart.




(1) RANGE SCALE
(2) STEREOSCOPIC PATTERN
(3) SIGHTING RETICLE
(4) AMMUNITION SCALE

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*Figure 7. Reticle patterns and scales.*

## 7. Tabulated Data

| | |
|---|---|
| Overall length | 64.75 in. |
| Overall depth | 25.375 in. |
| Overall height | 28.0 in. |
| Range | 500 to 5,000 yd. |
| Magnification | 7.5 power. |
| Base length | 60 in. |
| Exit pupil | 0.197 in. (5 mm). |
| Field of view | 5°. |
| Diopter adjustment | −3 to +3 diopters. |
| Interpupillary adjustment | 58mm to 72mm. |
| Total weight | 270 lb. |

## CHAPTER 2

## PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR FIELD AND DEPOT MAINTENANCE

### 8. General

Tools and equipment and maintenance parts over and above those available to the using organization are supplied to ordnance field maintenance units and depot shops for maintaining, repairing, and rebuilding the materiel.

### 9. Parts

Maintenance parts are listed in Department of the Army Supply Manual ORD 8 SNL F–356, Section 1, which is the authority for requisitioning replacements. Parts not listed in an ORD 8 manual, but required by depot shops in rebuild operations, may be requisitioned from the listing in the corresponding ORD 9 manual and will be supplied if available, when the need is substantiated. Requisitions for ORD 9 parts will contain a complete justification of requirements.

### 10. Common Tools and Equipment

Standard and commonly used tools and equipment having general application are authorized for issue by T/A and T/O & E.

### 11. Special Tools and Equipment

The special tools and equipment tabulated in table I are listed in Department of the Army Supply Manual ORD 6 SNL J–32. This tabulation contains only those special tools and equipment necessary to perform the operations described in this manual, is included for information only, and is not to be used as a basis for requisitions.

*Table I. Special Tools and Equipment for Field and Depot Maintenance*

| Item | Identifying No. | References | | Use |
|---|---|---|---|---|
| | | Fig. | Par. | |
| ADAPTER, erector cell assy | 7659162 | 8 | 324 | For supporting erector cell assembly on the lens bench during inspection. |
| ADAPTER, erector cell assy | 7659165 | 8 | 324 | For supporting erector cell assembly on the lens bench during inspection. |
| ADAPTER, objective | 7659159 | 8 | 324 | For supporting objective lens cell assembly on the lens bench during inspection. |
| BENCH, lens, vertical | 7658995 | 16 | 324 | For inspecting cell assemblies. |
| BOX, end, master | 7661528 | 17 | 407 | For making final inspection of range finder on the double collimator. |
| BRACKET, collimator, superelevation | 7661160 | 18 | 407 | For measuring angle of elevation on the range finder. |
| COLLIMATOR, double | 18–C–1279–25 | 19 | 384 through 405 | For final testing and adjusting of the range finder assembly. |
| COLLIMATOR, target | 7661426 | 20 | 344 | For adjusting the main telescope assembly. |
| Dioptometer | J022–7680631 | 9 | 344*g* | For adjusting the eyepiece diopter scale. |
| EXTENSION, torque wrench | J032–7680755 | 10 | 406 | For use with torque wrench 41–W–3628–125. |
| | J032–7680758 | 10 | | |
| | J032–7680754 | 10 | | |
| FIXTURE, adjustment, objective lens cell assy, erector cell assy. | 7660917 | 21 | 315 | For adjusting the prism support assembly. |
| FIXTURE, alinement, collimator | 7660850 | 22 | 290 | For preliminary alinement and focusing adjustments of the collimator assembly. |
| FIXTURE, alinement, optical axis, eyepiece assy. | 7658936 | 23 | 330 | For measuring divergence errors in the eyepiece assembly. |

| | | | | |
|---|---|---|---|---|
| FIXTURE, holder, adjusting | 7660961 | 24 | 320*c* | For adjusting the two-bonded prisms 7680596 prior to the assembly of the holder assembly into the main telescope assembly. |
| FIXTURE, test, IPD | 7661400 | 25 | 388, 389, 390, 391, 392 | For measuring interpupillary distance and for obtaining readings from which the base length error of the range finder can be computed. (Used in conjunction with the double collimator.) |
| GUN, hand, injection, with adapter J545–7648130. | J022–7648117 | 11 | 246*b* | To apply sealing compound. |
| GUN, hydraulic, injection, with adapter J545–7648130. | J022–7648134 | 12 | 250*h* | To apply sealing compound. |
| INDICATOR, synchro position | 7661524 | 26 | 379*b* | For setting the electrical zero and checking the rotation from zero position of the super elevation mechanism assembly. |
| INSTRUMENT, test, circuit | 7661530 | 27 | 405 | For checking for high voltage breakdown, leakage resistance and circuit continuity. |
| INSTRUMENT, test, superelevation | 7661030 | 28 | 379 | For timing and checking of the superelevation gear train and for timing the noncircular gears associated with the superelevation mechanism assembly. |
| INSTRUMENT, test, vibration | 7661921 | 29 | 411 | Simulates shock and handling conditions. |
| INTERFEROMETER | 7660790 | 30 | 26 | For measuring power and irregularity of windows, wedges, prisms and mirrors. |
| INTERFEROMETER, end housing | 7661516 | 31 | 263 | For measurement of image rotation and base length of the end housing assembly. |
| LIGHT SOURCE | 7661529 | 13 | 407 | For measuring the light transmission of the optical system. (Used in conjunction with the visual telephotometer on the double collimator.) |

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*Table I. Special Tools and Equipment for Field and Depot Maintenance*—Continued

| Item | Identifying No. | References | | Use |
|---|---|---|---|---|
| | | Fig. | Par. | |
| MISCROSCOPE, two objective | 7660892 | 32 | 344*a* | For adjusting the main telescope assembly on the target collimator. |
| REST, head | 7661780 | 33 | 399*b* | For checking and adjusting interpupillary distance of the eyepiece assembly on the double collimator. |
| STAND, test, pressure, end housing | 7661692 | 34 | 264 | For measuring pressure, drop of the end housing assembly. |
| TELEPHOTOMETER, visual | 7661575 | 35 | 408 | For measuring the optical transmission of the range finder on the double collimator. |
| TELESCOPE, with stand | 7661526 | 36 | 385, 387 | For measurement of the resolving power on the double collimator. |
| VIEWER, image, erector | 7660900 | 37 | 344*d* | For making final focus setting of the erector cell assembly 7632932 and for setting the two bonded prisms 7680596 of the main telescope assembly. |
| WRENCH, focusing | 7659139 | 38, 117 | 132, 339*c* | For focusing erector cell assembly 7632933 in the main telescope assembly. |
| WRENCH, set, tubular | 41–W–3725–850 | 15 | | |
| Consisting of: | | | | |
| WRENCH, tubular, dble-end, concave inserted blade, size 0.687 and 0.703 in ($^{11}/_{16}$ and $^{45}/_{64}$ in.). | 41–W–3726–38 | 15 | 188*b*, 203*b*, 204*d*, 254*a*, 255*a*. | Remove or install condenser lens retaining ring. |
| WRENCH, tubular, dble-end, concave inserted blade, size 0.719 and 0.734 in. $^{23}/_{32}$ and $^{47}/_{64}$ in.). | 41–W–3726–40 | 15 | 216*d* and *p*, 242*f* and *s*. | Remove or install filter rotating shaft bearing retaining collar. |

| | | | | |
|---|---|---|---|---|
| WRENCH, tubular, dble-end, concave inserted blade, size 2.750 and 2.766 in. (2¾ and 2$^{49}$⁄$_{64}$ in.). | 41–W–3726–330 | 15 | 147*a*, 246, 321*e*, 336*b*. | Remove or install telescope housing bearing retaining ring. |
| WRENCH, strap | 41–W–3382 | 14 | 134*a*, 135*a*, 136, 334*a*, 336*c*, 337d. | For removing telescope mounting bearing. |
| WRENCH, telescope | 7659126 | 39, 117 | 132, 339*b*, 334*d* | For focusing erector cell assembly 7632932 in the main telescope assembly. |
| WRENCH, torque | 41–W–3628–125 | 10 | 82, 84, 416*a* | For attaching the end housings after installation of rangefinder in tank. |
| WRENCH, torque, with adapters | 7660767 | 40 | 406 | For measuring torque of the hand knobs on the rangefinder. |
| WRENCH, tubular, dble-end, concave inserted blade, size 1.125 and 1.141 in. (1⅛ and $^{9}$⁄$_{64}$ in.). | 41–W–3726–98 | 15 | 139*a*, 196*d*, 263*d*, 329*d*. | Disassembly and reassembly of cell assembly. |
| WRENCH, tubular, dble-end, concave inserted blade, size 1.250 and 1.266 in. (1¼ and 1$^{17}$⁄$_{64}$ in.). | 41–W–3726–113 | 15 | 151, 198*a*, 260*e*, 319*b*. | Remove or install collective lens cell retaining ring. |
| WRENCH, tubular, dble-end, concave inserted blade, size 1.437 and 1.453 in. (1$^{7}$⁄$_{16}$ and 1$^{29}$⁄$_{64}$ in.). | 41–W–3726–143 | 15 | 152, 318*b* | Remove or install collective lens cell retaining ring. |
| WRENCH, tubular, dble-end, concave inserted blade, size 1.469 and 1.484 in. (1$^{15}$⁄$_{32}$ and 1$^{31}$⁄$_{64}$ in.). | 41–W–3726–150 | 15 | 150, 331*a*, 320*b* | Remove or install collective lens cell assemblies. |
| WRENCH, tubular, dble-end, concave inserted blade, size 1.594 and 1.609 in. (1$^{19}$⁄$_{32}$ and 1$^{33}$⁄$_{64}$ in.). | 41–W–3726–170 | 15 | 145, 323*a*, 344*a* | Disassembly and reassembly of objective lens cell assembly. |
| WRENCH, tubular, dble-end, concave inserted blade, size 1.687 and 1.703 in. (1$^{11}$⁄$_{16}$ and 1$^{45}$⁄$_{64}$ in.). | 41–W–3726–183 | 15 | 144*a*, 325*b*, 326*b* | Disassembly and reassembly of erector cell assemblies. |

*Table I. Special Tools and Equipment for Field and Depot Maintenance*—Continued

| Item | Identifying No. | References | | Use |
|---|---|---|---|---|
| | | Fig. | Par. | |
| WRENCH, tubular, dble-end, concave inserted blade, size 1.719 and 1.734 in. ($1\frac{23}{32}$ and $1\frac{47}{64}$ in.). | 41–W–3726–190 | 15 | 188*e*, 268*a*, 273 | Remove or install correction wedge gear and outer collimator lens retaining ring. |
| WRENCH, tubular, dble-end, concave inserted blade, size 1.781 and 1.797 in. ($1\frac{25}{32}$ and $1\frac{51}{64}$ in.). | 41–W–3726–200 | 15 | 338 | Remove or install objective lens cell assembly. |
| WRENCH, tubular, dble-end, concave inserted blade, size 1.750 and 1.766 in. ($1\frac{3}{4}$ and $1\frac{49}{64}$ in.). | 41–W–3726–195 | 15 | 216*a* and *b*, 217*a*, 241*f*, 242*u*. | Remove or install filter and compensator lens retaining ring. |
| WRENCH, tubular, dble-end, concave inserted blade, size 2.000 and 2.016 in. (2 and $2\frac{1}{64}$ in.). | 41–W–3726–240 | 15 | 133*b*, 195*d*, 266*c*, 338, 344*a*. | Remove or install objective lens retaining ring. |
| WRENCH, tubular, dble-end, concave inserted blade, size 2.281 and 2.297 in. ($2\frac{9}{32}$ and $2\frac{19}{64}$ in.). | 41–W–3726–285 | 15 | 196*a*, 211*a*, 262*d* and *k*. | Remove or install end housing window retaining ring. |
| YOKE | 7658885 | 41 | 384 | For attaching the range finder to the double collimator and for hoisting the range finder to the correct level for attachment. |

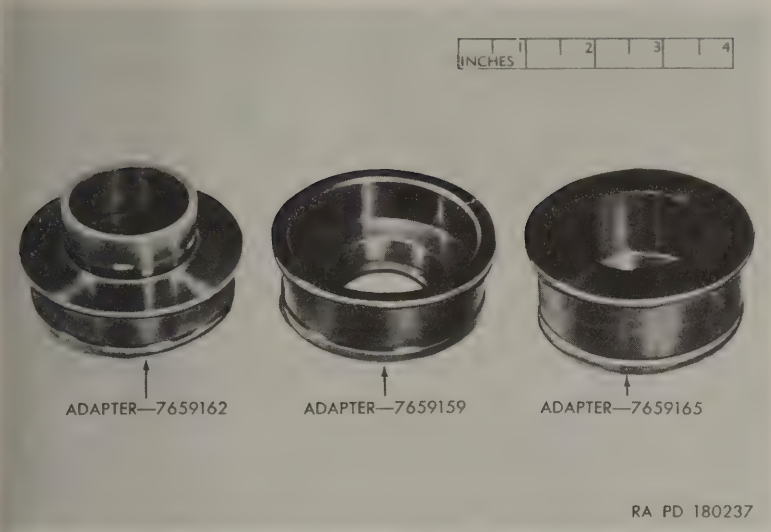



*Figure 8. Erector cell assembly adapters 7659162, 7659165, and 7659159.*

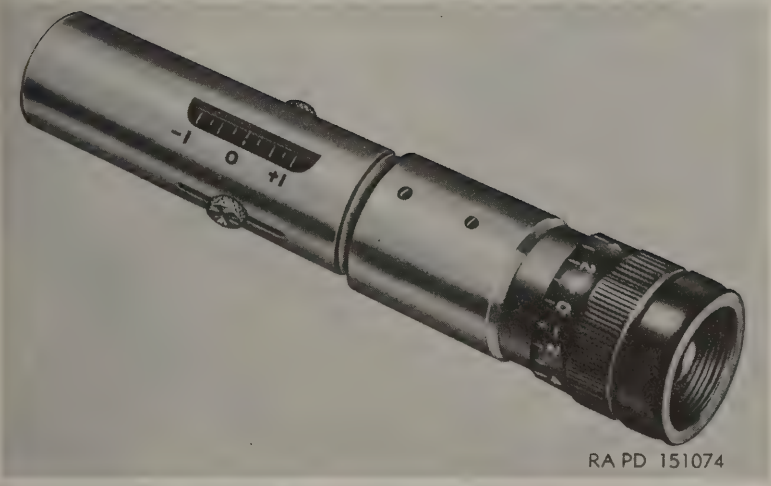



*Figure 9. Dioptometer.*

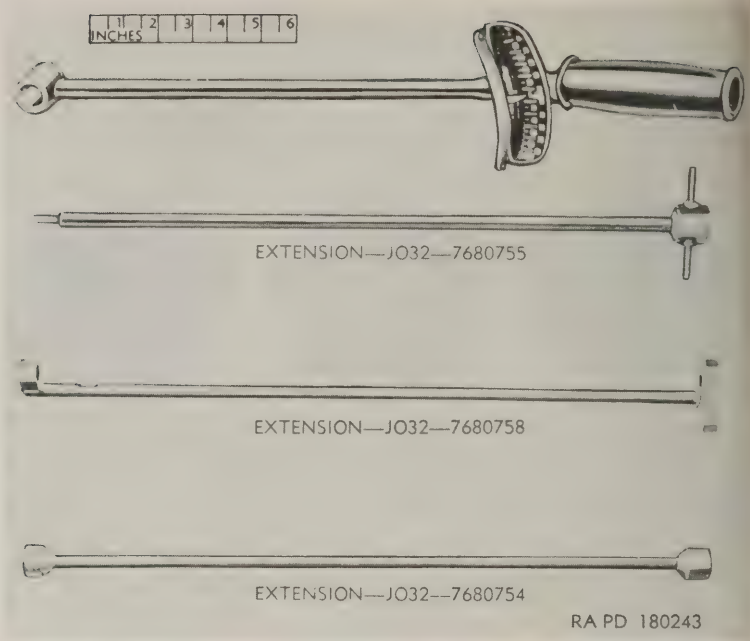



*Figure 10. Torque wrench 41–W–3628–125 and extensions J032–7680755, J032–7680758, and J032–7680754.*

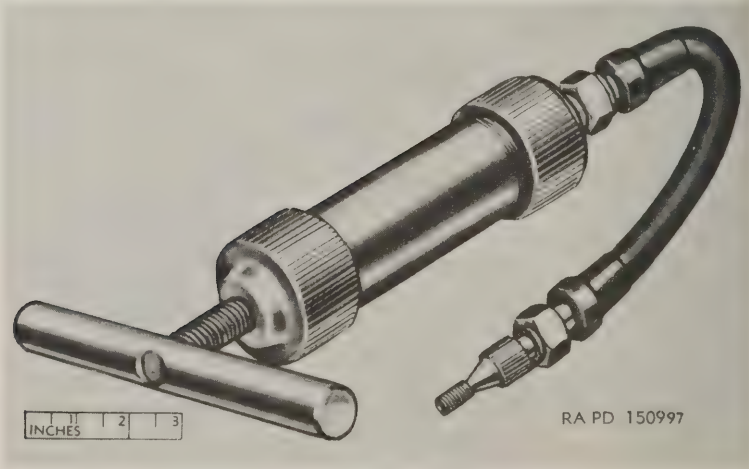



*Figure 11. Hand injection gun J022–7648117 with adapter J545–7648130.*

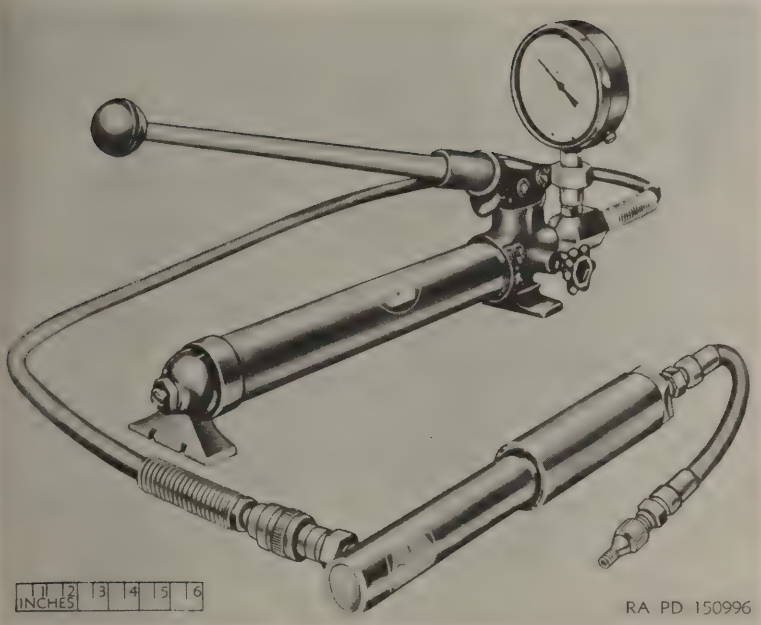



*Figure 12. Hydraulic injection gun J022–7648134 with adapter J545–7648130.*

*Figure 13. Light source 7661529.*

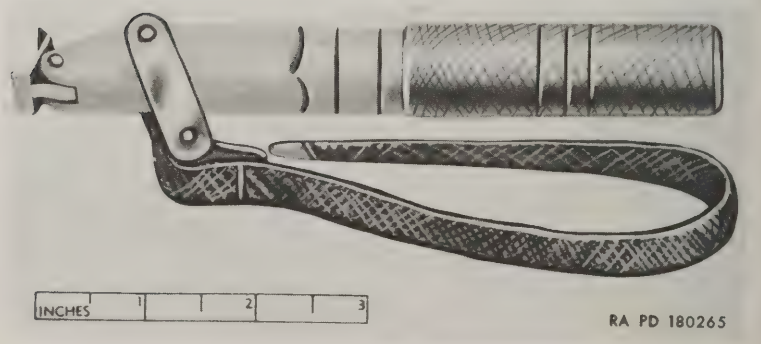



*Figure 14. Strap wrench 41–W–3382.*

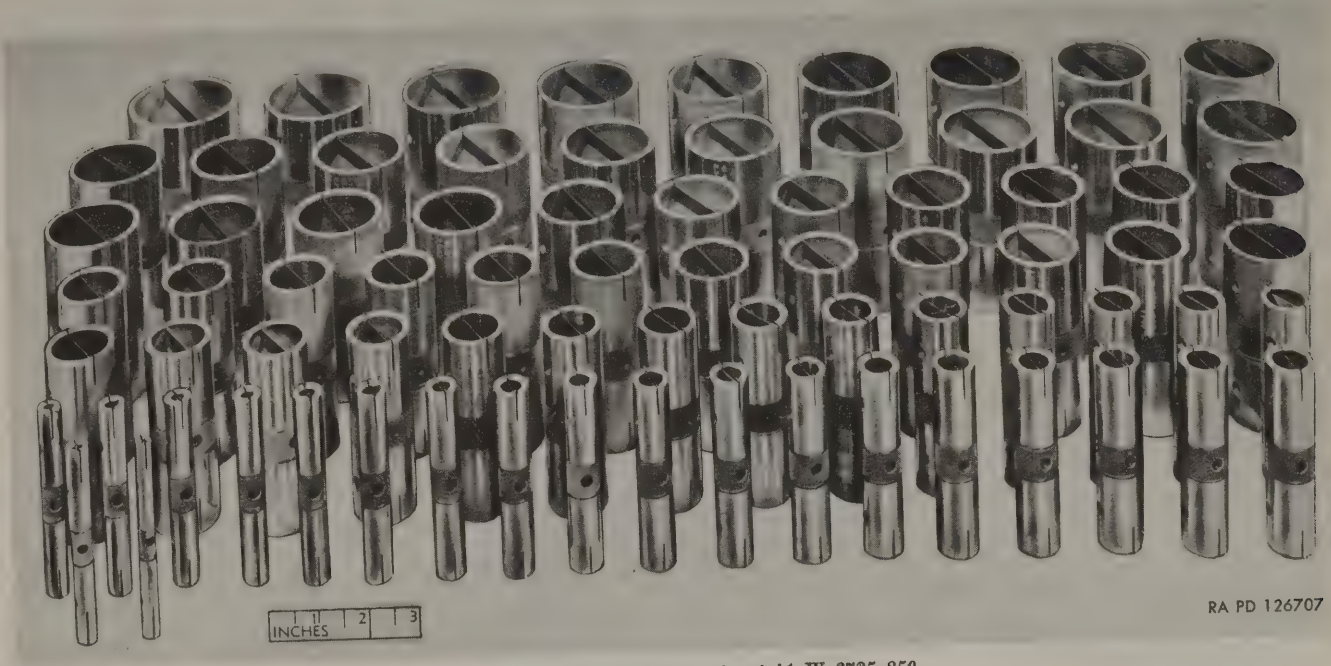



*Figure 15. Tubular wrench set 41–W–3725–850.*

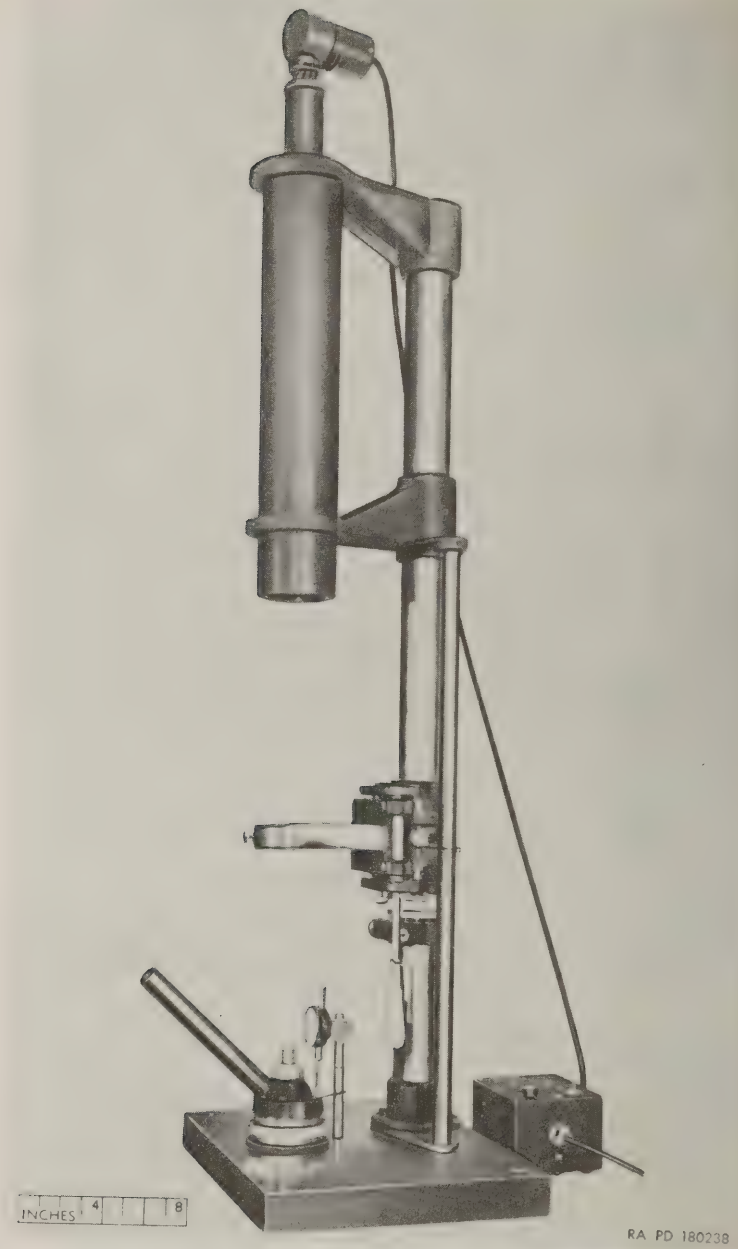



*Figure 16. Vertical lens bench 7658995.*

## 12. Lens Bench 7658995

The lens bench (fig. 16) is an optical instrument for inspecting mounted cell assemblies. It consists of a column which supports a light source, a collimator, and an adjustable support for holding adapters. Mounted on the base of the instrument is a 16-mm microscope objective which can be adjusted up or down for compensating adjustments. A dial, calibrated in inches, indicates the extent of microscope adjustment. The microscope has a 10-power eyepiece that contains a reticle. The instrument is set with a master objective and readings are made to given tolerances. The bench is used to check strain during the mounting of the objective which may cause fractures or optical center runout.

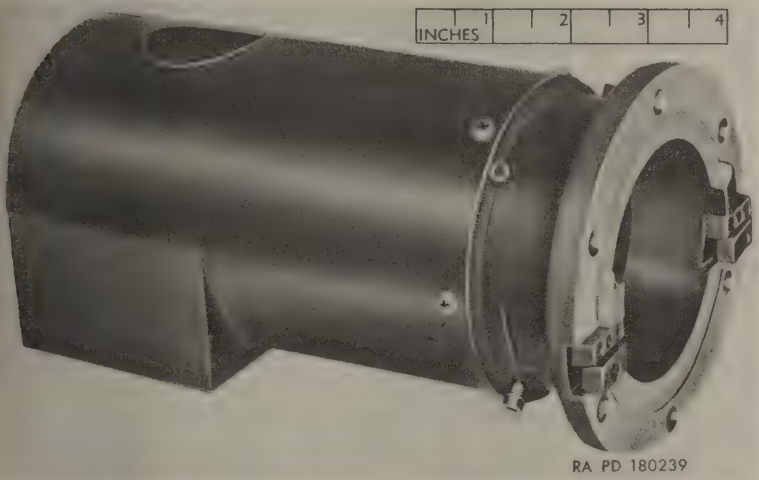



*Figure 17. Master end box 7661528.*

## 13. Master End Box 7661528

The master end box (fig. 17) is a certified end housing used in place of production end housing assemblies during testing and adjustment of the main assembly. It is used during adjustment for base length, power, elevation, and deviation.

## 14. Superelevation Collimator Bracket 7661160

The superelevation collimator bracket (fig. 18) is a wide field collimator with a mil scale on the reticle running from 0 to 90 mils. It is used on the double collimator to measure the angle through which the range finder elevates as the knobs of the ballistic computing system are adjusted.

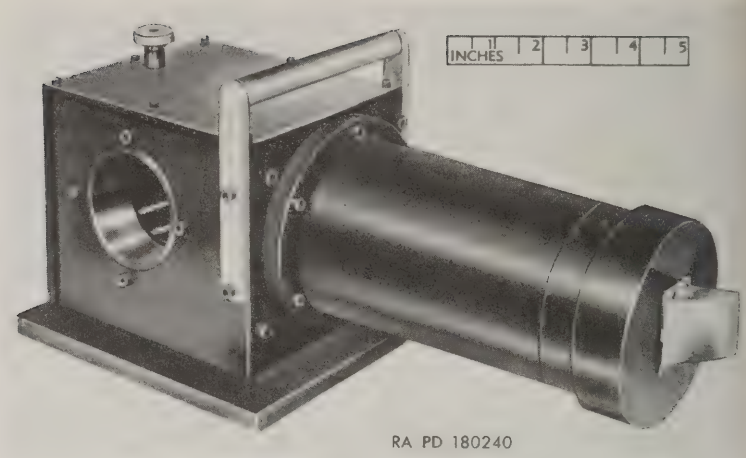



*Figure 18. Superelevation collimator bracket 7661160.*

## 15. Double Collimator 18–C-1279–25

The double collimator (fig. 19) provides a frame upon which the range finder is mounted for final inspection and adjustment. It consists of a pair of collimators which are arranged to move in elevation from 20° up to 15° down; a variable angle wedge unit to change the direction of the line of sight of one collimator to simulate different ranges; and reference marks for measuring base length. The following test fixtures are used in conjunction with the double collimator; IPD test fixture, superrelevation collimator bracket, syncro position indicator, torque wrench, telescope with stand, master end box, yoke, light source, and visual telephotometer.

## 16. Target Collimator 7661426

The target collimator (fig. 20) has a pair of end-on collimators mounted on opposite ends of a beam. The beam has an adapter for mounting the main telescope assembly between the collimators. The fixture is designed to simulate the rotation of the main housing and end housings assemblies from +20° to −15° elevation. A support is provided to keep the telescope assembly at a fixed orientation in space as the collimators and telescope bearings are rotated.

## 17. Objective Lens Cell Assembly and Erector Cell Adjustment Fixture 7660917

The objective lens cell assembly and erector cell adjustment fixture (fig. 21) is a fixture consisting of a collimator with reticle, a support for the support prism assembly, an objective lens, a telescope, and a

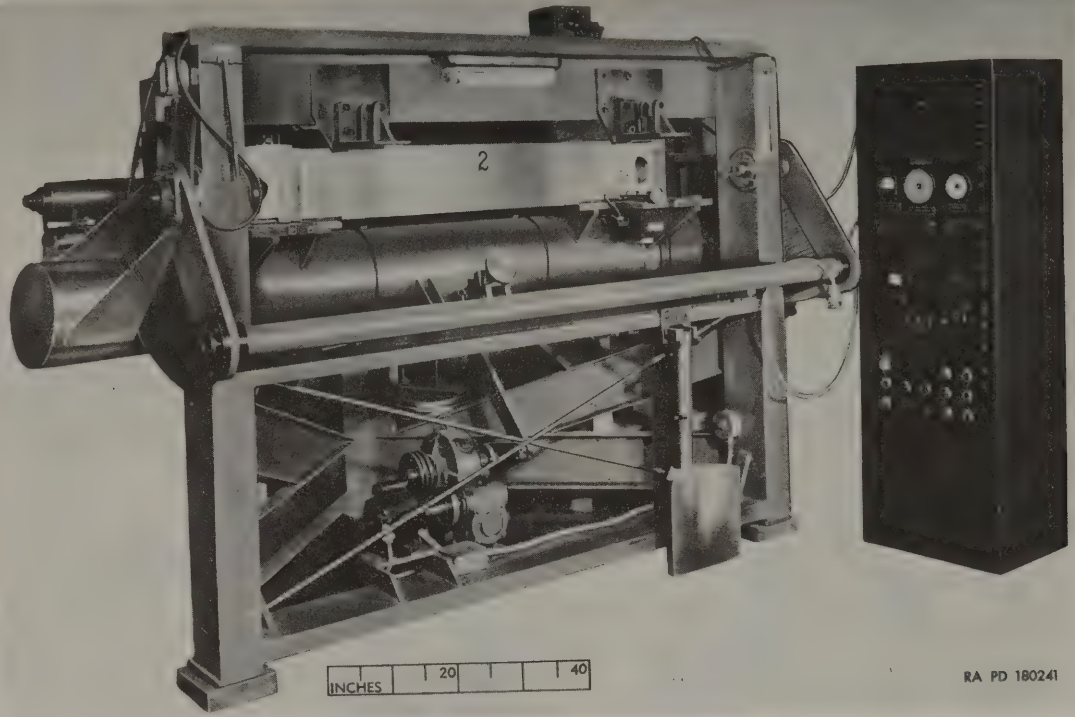



*Figure 19. Double collimator 18–C–1279–25.*

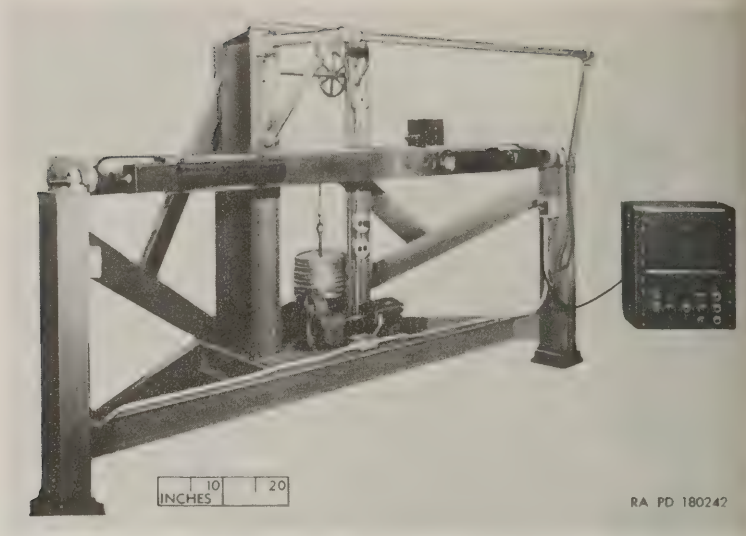



*Figure 20. Target collimator 7661426.*

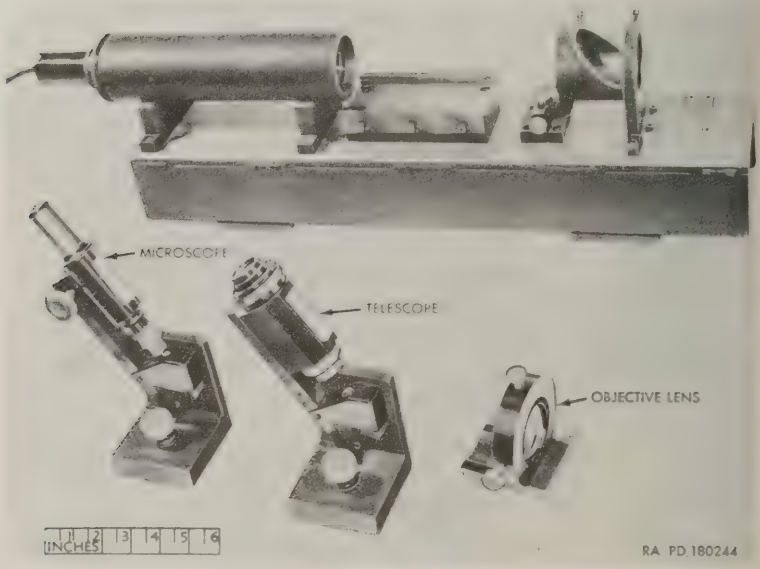



*Figure 21. Objective lens cell assembly and erector cell adjustment fixture 7660917.*

microscope. The fixture provides a means of mounting the microscope and the telescope for adjusting the support prism assembly for parallel and converging light.

## 18. Collimator Alinement Fixture 7660850

The collimator alinement fixture (fig. 22) is a bench fixture consisting of a support for the collimator assembly, telescopes mounted at each end of the base, and a regulated light source. The telescopes are used to observe the images delivered from the collimator during preliminary alinement and focusing.

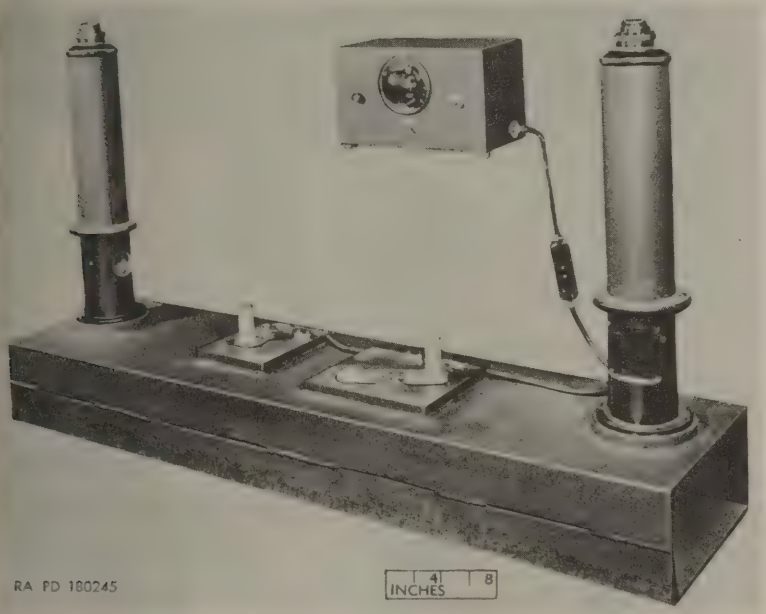



*Figure 22. Collimator alinement fixture 7660850.*

## 19. Eyepiece Optical Axis Alinement Fixture 7658936

This fixture (fig. 23) duplicates the surfaces upon which the range finder eyepiece assembly is mounted. It provides a pair of reticle images at the same position, relative to the mounting, as the images formed by the range finder erectors. A double telescope is provided to measure divergence errors in the eyepiece assembly.

## 20. Holder Adjusting Fixture 7660961

The holder adjusting fixture (fig. 24) is a bench stand which supports a ground glass screen, two objective lenses which simulate the objective lenses of the main telescope assembly, the prism and collective lens assembly 7631275, and the two prism support assemblies

7633000. The fixture is used to adjust the two prism support assemblies to the collective lens assembly before the units are assembled into tube 7633162. The image of the reference reticle is projected to a ground glass screen which has reference and tolerance lines.

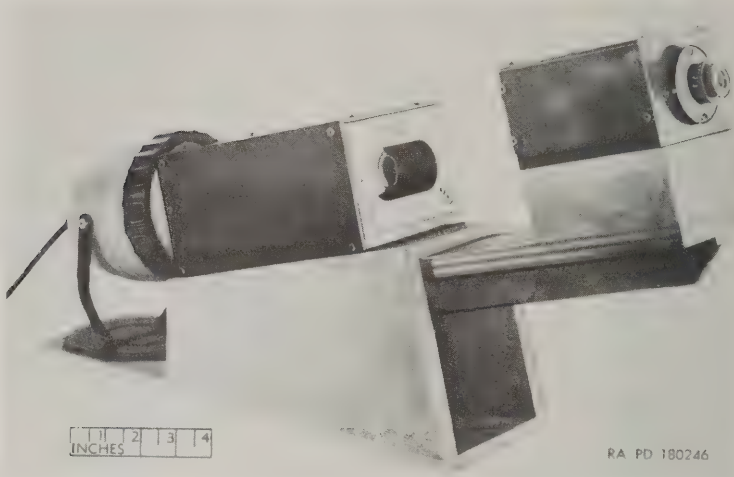



*Figure 23. Eyepiece optical axis alinement fixture 7658936.*

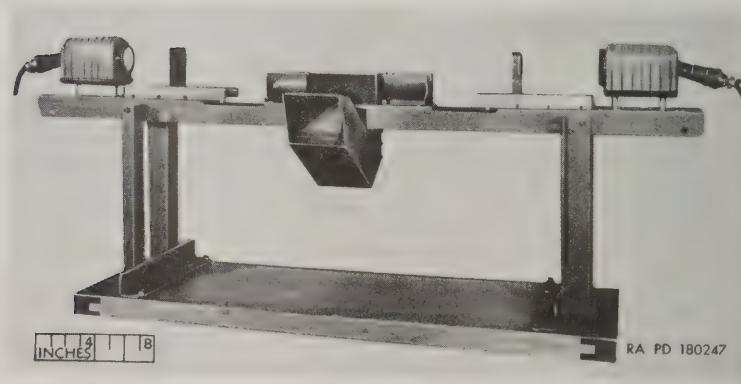



*Figure 24. Holder adusting fixture 7660961.*

## 21. IPD Test Fixture 7661400

The IPD test fixture assembly (fig. 25) is a two-objective telescope with a combining prism that fuses images of a distant object for observation in a single eyepiece. The fixture is supported on an adapter stand so that it can be mounted to look into the eyepieces of the range finder. In this position, measurements of divergence error can be made.

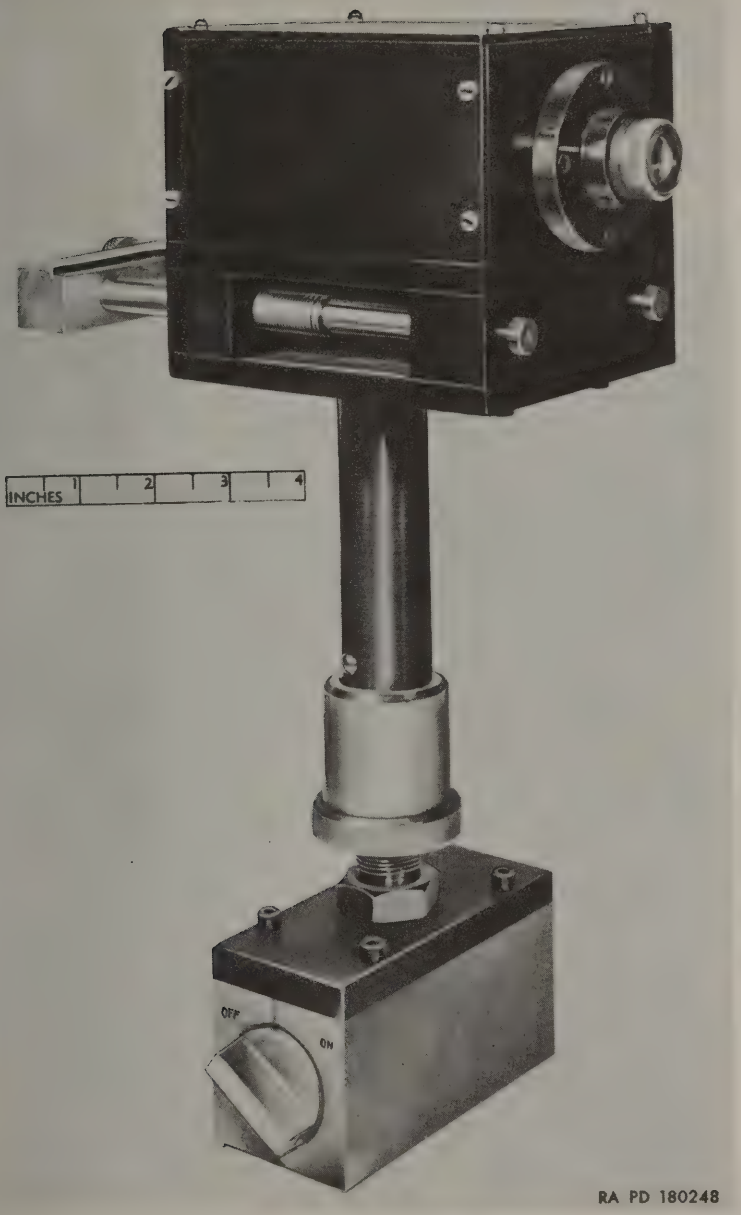
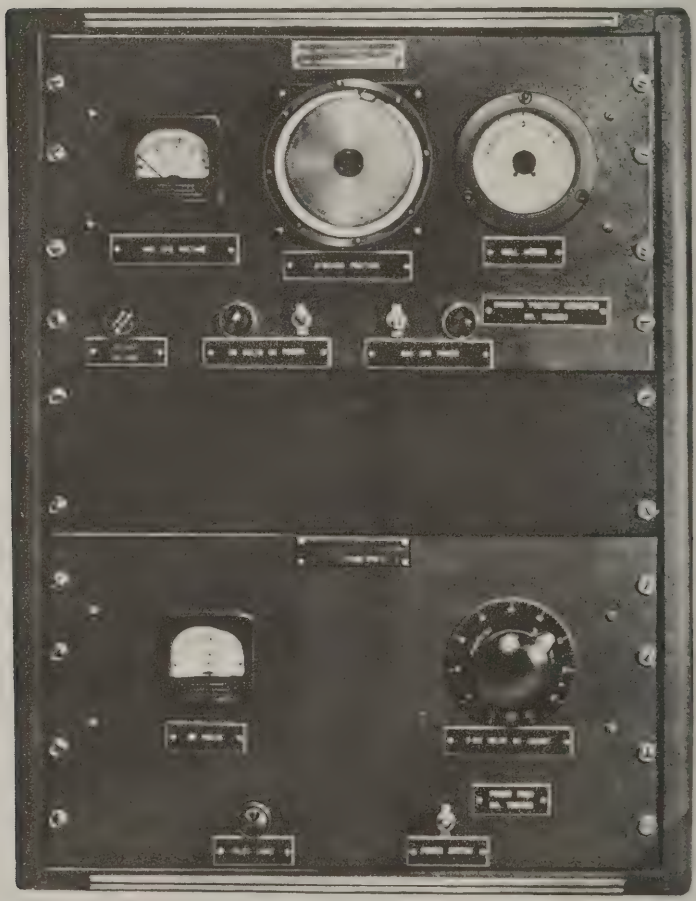



*Figure 25. IPD test fixture 7661400.*

## 22. Synchro Position Indicator 7661524

The synchro position indicator assembly (fig. 26) is an electrical device consisting of a null meter for setting the electrical zero of the superelevation mechanism assembly, a self-synchronous repeater to indicate the rotation of the superelevation mechanism assembly from its 0 position, and a power pack which supplies 115-volt, 400-cycle, ac power and 24-volt dc power to operate the synchro position indicator. The power pack also provides 6.3-volt, ac and high voltage dc for the null meter and will operate on 115- to 120-volt, 60-cycle, ac.



RA PD 180249

*Figure 26. Synchro position indicator 7661524.*

## 23. Circuit Test Instrument 7661530

The circuit test instrument (fig. 27) is an electrical instrument which operates on 115-volt, 60-cycle alternating current. The instrument is used to measure circuit continuity, high potential insulation breakdown, and insulation resistance.

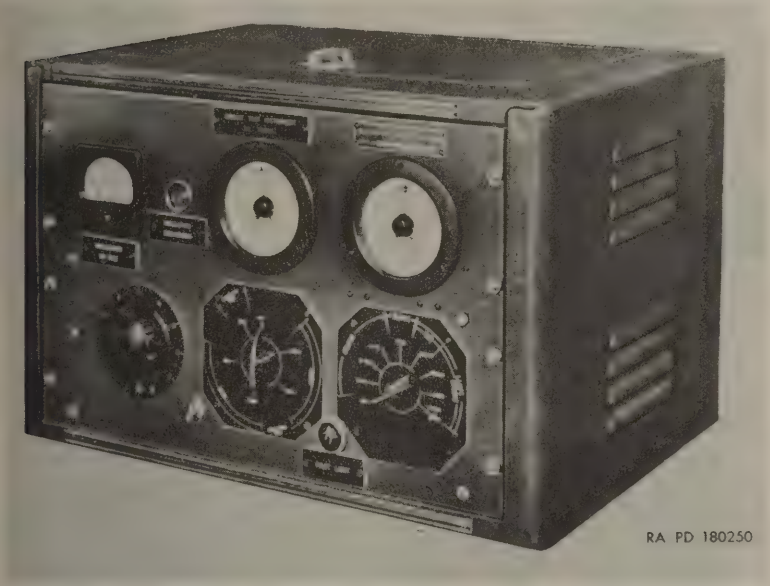



*Figure 27. Circuit test instrument 7661530.*

## 24. Superelevation Test Instrument 7661030

The superelevation test instrument (fig. 28) consists of the three parts indicated in *a* through *c* below.

*a.* A stand to support the range finder and a wide field target collimator with a reticle marked with superelevation angles for various range and ballistic combinations.

*b.* A viewing telescope which mounts on the main housing in the position of the right end housing assembly so that it points at the target collimator.

*c.* A telescope and prism assembly to be used for reading the range and ammunition scales produced in the range collimator. The yoke is used to support the range finder on this instrument.

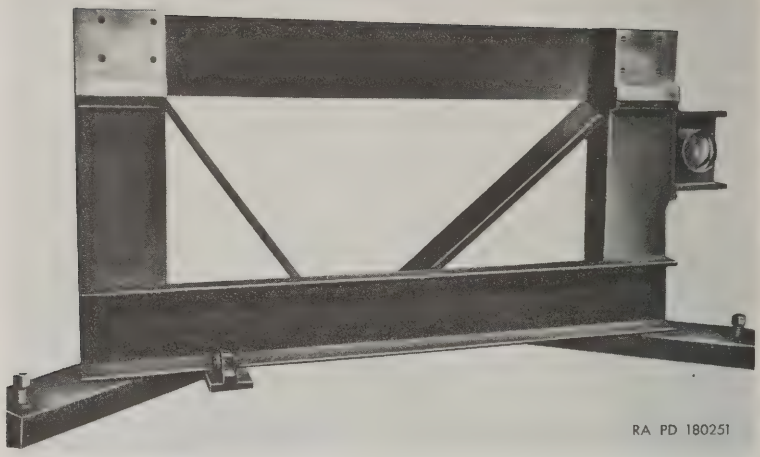



*Figure 28. Superelevation test instrument 7661030.*

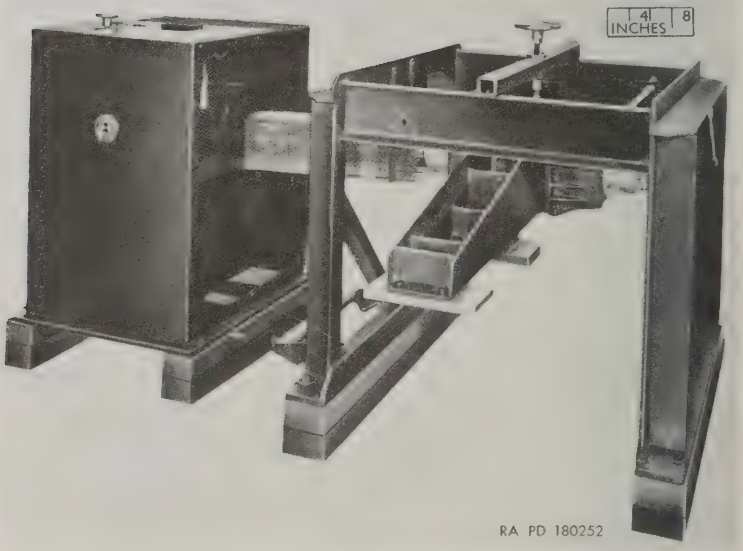



*Figure 29. Vibration test instrument 7661921.*

## 25. Vibration Test Instrument 7661921

The vibration test instrument (fig. 29) is a motor-driven vibrator with appropriate adapters for various fire control items. It is used to determine that all parts are properly secured and that all dirt has been removed. The equipment normally operates on 3-phase, 60-cycle alternating current. However, it can be wired at the factory for operation on 208-, 220- or 440-volt.

## 26. Interferometer 7660790

The interferometer (fig. 30) uses a mercury light source filtered to use the light of 0.546 micron wave length. A surface plate, shock mounted to avoid floor vibration, supports the components of the instrument. A beam-splitter, which produces about 70 percent reflection and 10 percent transmission, reflects two light beams from mirrors

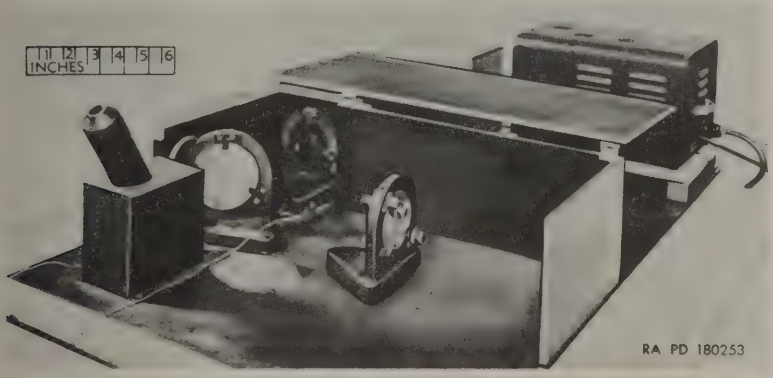



*Figure 30. Interferometer 7660790.*

that are about equal distance from the beam-splitter. These beams are recombined at the beam-splitter to form a pattern of interference fringes. Observations of these fringe patterns enable the operator to detect spherical and cylindrical surfaces as well as structural defects in the piece being tested. Actually, the observation is a comparison to exact parallelism of the two wave fronts which exist in the interferometer before the test piece is placed in position.

## 27. End Housing Interferometer 7661516

The end housing interferometer (fig. 31) is specially designed to measure power, irregularity, deviation, and halving error in the end housing assemblies. Additional end markers are provided at the end mirrors of the interferometer which permit measurement of image rotation and base length. Micrometers are used to measure deviation from a predetermined setting of the interferometer.

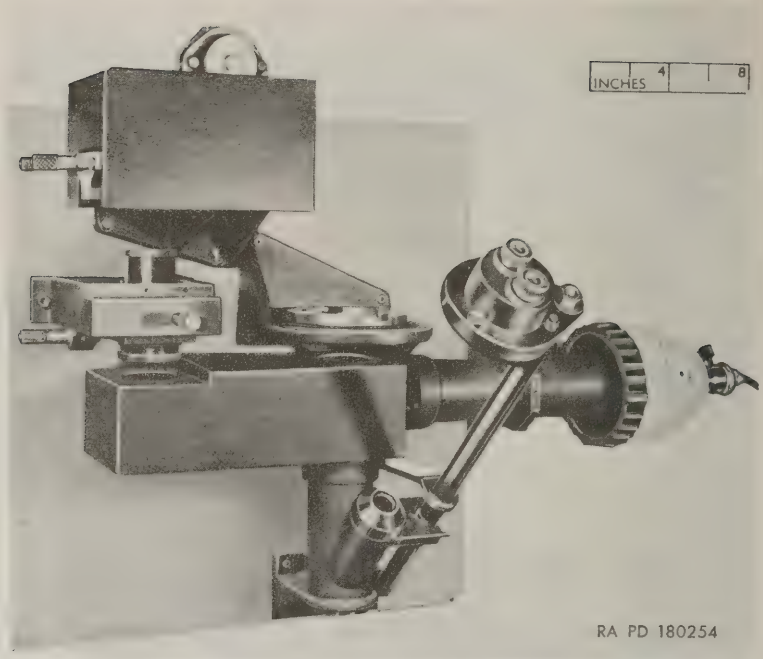



*Figure 31. End housing interferometer 7661516.*

## 28. Two Objective Microscope 7660892

The two objective microscope (fig. 32) is two microscope objectives mounted to deliver images through a combining prism to a single eyepiece with reticle. It is used on the target collimator for adjusting the telescope assembly.

## 29. Head Rest 7661780

The head rest (fig. 33) is an adapter that mounts around the two eyepieces of the range finder. It supports a mask with two apertures that fall on the exit pupils of the range finder. Controlled lateral movement is provided to be used in measurement of stereo parallax. The distance between the two apertures in the mask must be matched to the IPD of the observer.

## 30. End Housing Pressure Test Stand 7661692

The end housing pressure test stand (fig. 34) consists of manometers arranged to show the difference in pressure between the end housing assemblies being tested and a tank of equal volume known

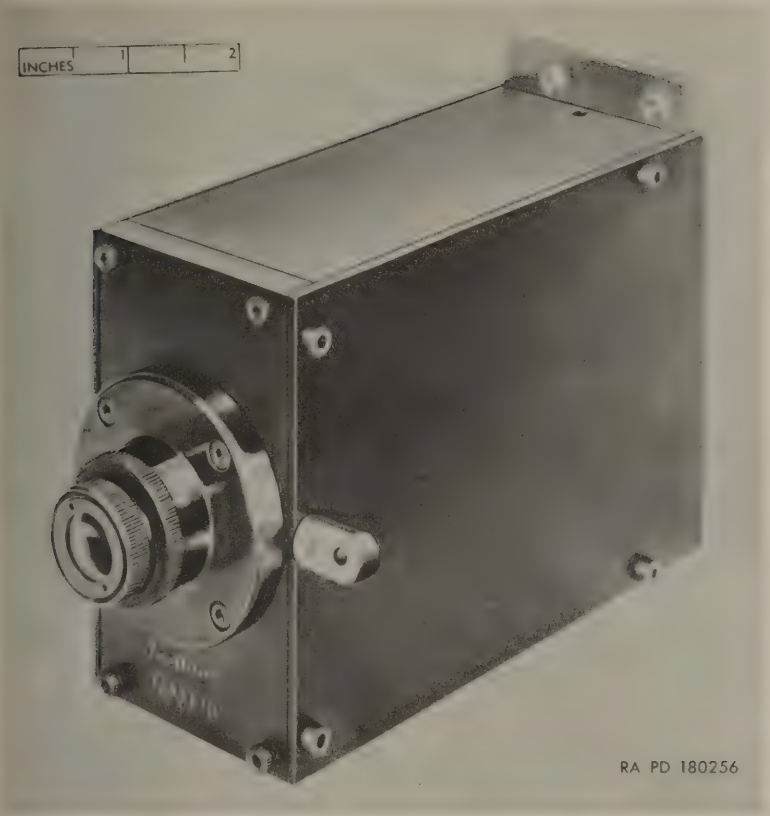



*Figure 32. Two objective microscope 7660892.*

to be well sealed. The two volumes (end housing and tank) are isolated except through the manometer, which measures pressure difference.

## 31. Visual Telephotometer 7661575

The visual telephotometer (fig. 35) is a telescope with a field of view surrounded by an annular area of uniform brightness. The brightness can be changed by a measurable amount by means of a rheostat. The telephotometer is supplied with a base for supporting the instrument in front of the range finder eyepieces.

## 32. Telescope with stand 7661526

The telescope with stand (fig. 36) is a 6-power telescope which can be focused in the object space one-eighth diopter. It is supported by a stand so that it can be mounted to look into either eyepiece of the range finder.

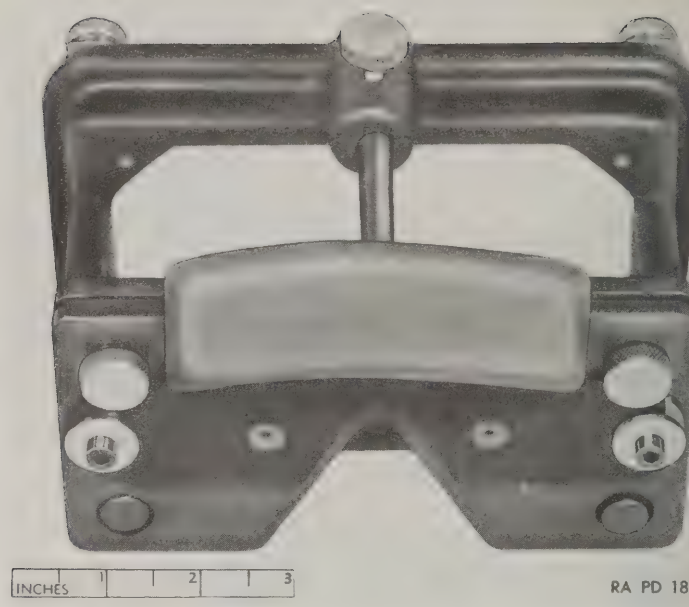



*Figure 33. Head rest 7661780.*

## 33. Erector Image Viewer 7660900

The erector image viewer (fig. 37) is essentially a master eyepiece assembly which is used to observe the images delivered by the erector lenses to the eyepiece assembly.

## 34. Focusing Wrench 7659139

The focusing wrench (fig. 38) is a combination spanner wrench and mount for a ground glass screen to be used in a rough adjustment of the second erector in both the right and left beams.

## 35. Telescope Wrench 7659126

The telescope wrench (fig. 39) is a combination telescope and spanner wrench which forms a close fit in the bore of the erector sections of the main telescope. It is used as a viewing device and wrench in the adjustment of the first erector cell assembly and the right angle prisms in both the right and left beams.

*Figure 34. End housing pressure test stand 7661692.*

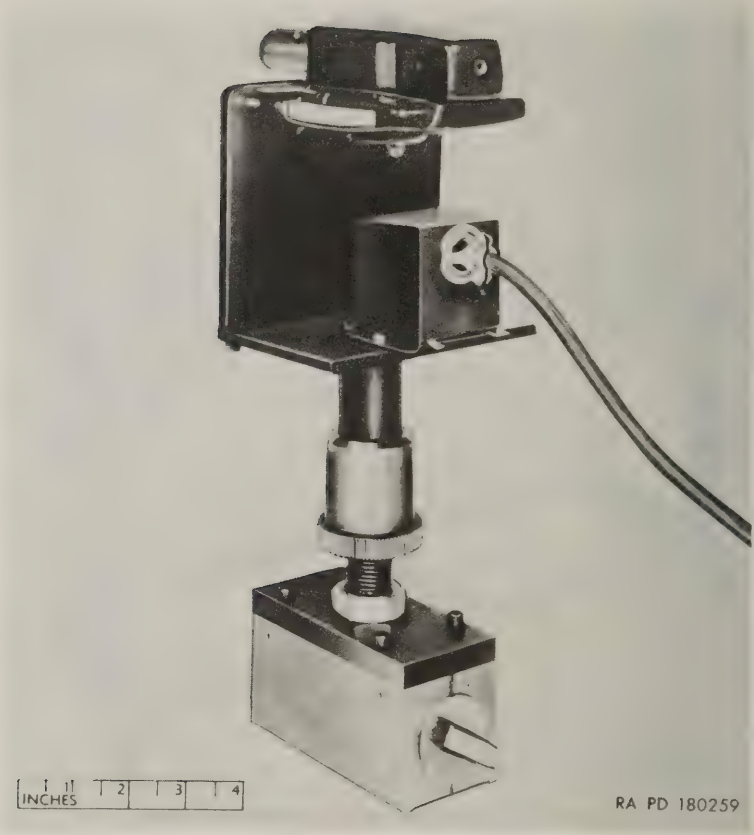



*Figure 35. Visual telephotometer 7661575.*

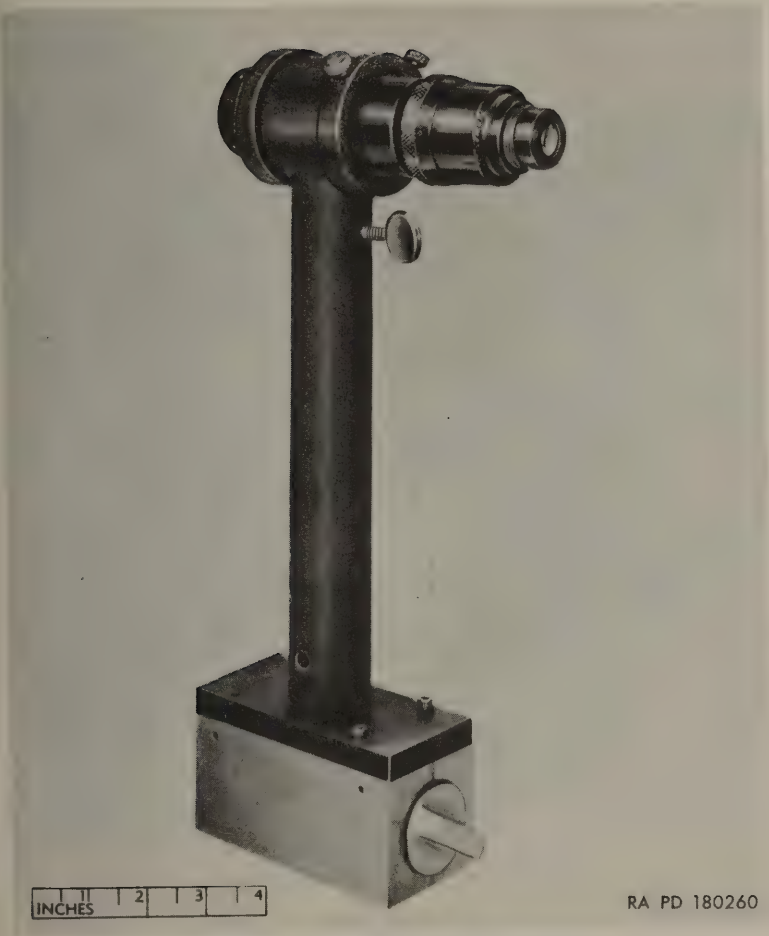



*Figure 36. Telescope with stand 7661526.*

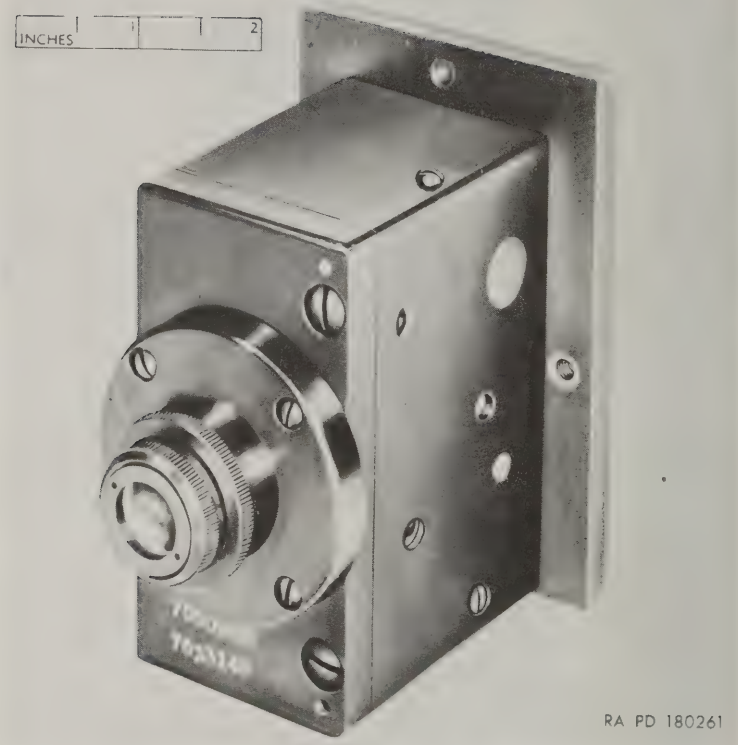



*Figure 37. Erector image viewer 7660900.*

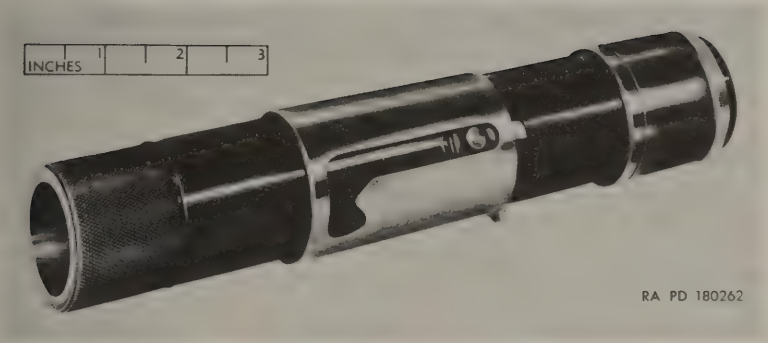



*Figure 38. Focusing wrench 7659139.*

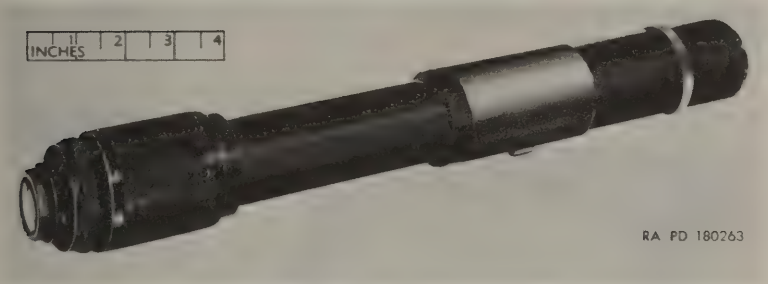



*Figure 39. Telescope wrench 7659126.*

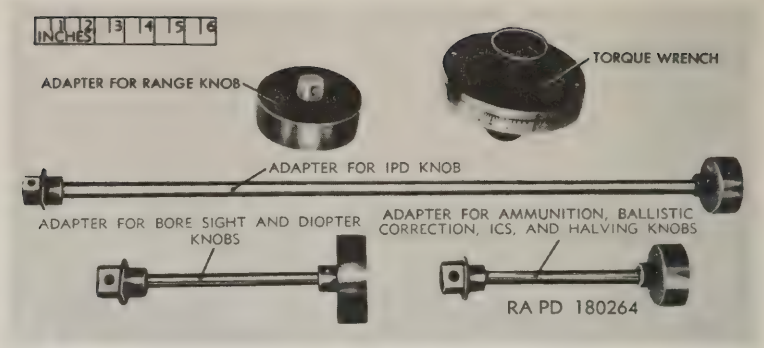



*Figure 40. Torque wrench with adapters 7660767.*

## 36. Torque Wrench with Adapters 7660767

The torque wrench (fig. 40) consists of the wrench and four adapters for measuring the torque of the various knobs on the range finder. The wrench is a spring-type wrench and the adapters have extensions of varying lengths for convenient operation.

## 37. Yoke 7658885

The yoke (fig. 41) is a steel member used for supporting the range finder when it is hoisted on and off the double collimator. The brackets, which are a part of the yoke, attach the range finder to the double collimator.

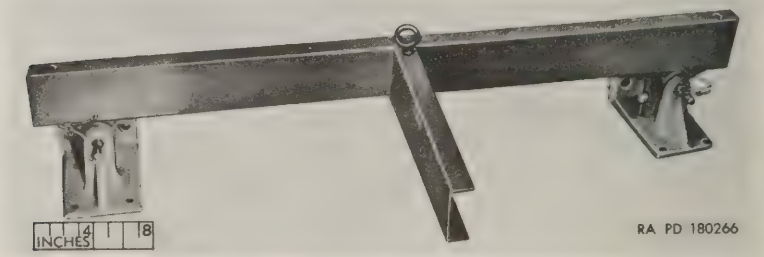



*Figure 41. Yoke 7658885.*

## 38. Improvised Tools

The list of improvised tools in table II applies only to field and depot organizations performing major rebuild work on range finder M12 or T41. Illustrations giving dimensioned details are included to enable these maintenance organizations to fabricate these tools locally, if desired. The chief value of these tools is to maintenance organizations engaged in rebuilding a large number of range finders. These tools are essential for rebuild but are not available for issue. The following data are furnished for information only.

*Table II. Improvised Tools for Field and Depot Maintenance*

| Item | Identifying No. | References | | Use |
|---|---|---|---|---|
| | | Fig. | Par. | |
| CRADLE, telescope | | 42, 43 | 409 | Used to support telescope assembly during immersion test. |
| SCREW, holding | 7662083 | 44 | 154*a*, 298*a* | For removal and installation of ballistic cam and related parts. |
| WRENCH, bar, 0.477 in | | 45 | 134*a*, 135*a*, 136, 334*a*, 336*c*, 337*d*. | To hold tubes in position when removing or installing mating parts. |
| WRENCH, cell assembly | 7633137 | 46 | 196*g* | For removing or installing azimuth correction cell assembly. |
| WRENCH, valve, desiccation | | 47 | 117, 262*e* | For removing or installing valve cap 7648925 from the end housing assembly. |
| WRENCH, hook spanner, 2⅛ in | | 48 | 329*h* | For removing or installing retaining rings which have slots in the ring. |
| WRENCH, hook spanner, 6⅞ in | | 49 | 96*c*, 370*a* | For removal or installation of large bearing retaining rings. |
| WRENCH, pin-type spanner, 2.4 in | | 51 | 188*c*, 273*c*, 290*e* | For removing or installing retaining rings which have holes on the face of the retaining ring to receive the wrench. |
| WRENCH, pin-type spanner, 2.5 in | | 52 | 146, 322*b* | For removing or installing retaining rings which have holes on the face of the retaining ring to receive the wrench. |
| WRENCH, pin-type spanner, 2.7 in | | 53 | 137*a*, 333*a* and *c* | For removing or installing retaining rings which have holes on the face of the retaining ring to receive the wrench. |

*Table II. Improvised Tools for Field and Depot Maintenance*—Continued

| Item | Identifying No. | References | | Use |
|---|---|---|---|---|
| | | Fig. | Par. | |
| WRENCH, pin-type spanner, $1\frac{11}{16}$ in | | 54 | 261*d* | For the removal or installation of retaining rings when the shafts project through the rings. |
| WRENCH, main bearing | 7662086 | 50 | 210*a*, 247*b* | For disassembling the bearing assemblies. |
| WRENCH, single pin-type spanner | | 55 | 134*b* | For removing or installing external retaining rings with hole on the outside diamater of the ring. |
| WRENCH, tubular, $\frac{3}{8}$ in | | 56 | 273*d* | Used for removal or installation of retaining ring when a shaft projects through the retaining ring. |
| WRENCH, tubular, $\frac{5}{8}$ in | | 57 | 216*l*, 217*d*, 218*c*, 240*b*, 241*a*, 242*j*, 278*c*. | For removal or installation of retaining rings with slots on the face of the retaining ring. |
| WRENCH, tubular, $1\frac{1}{8}$ in | | 58 | 181*b* | For removing or installing retaining rings. |

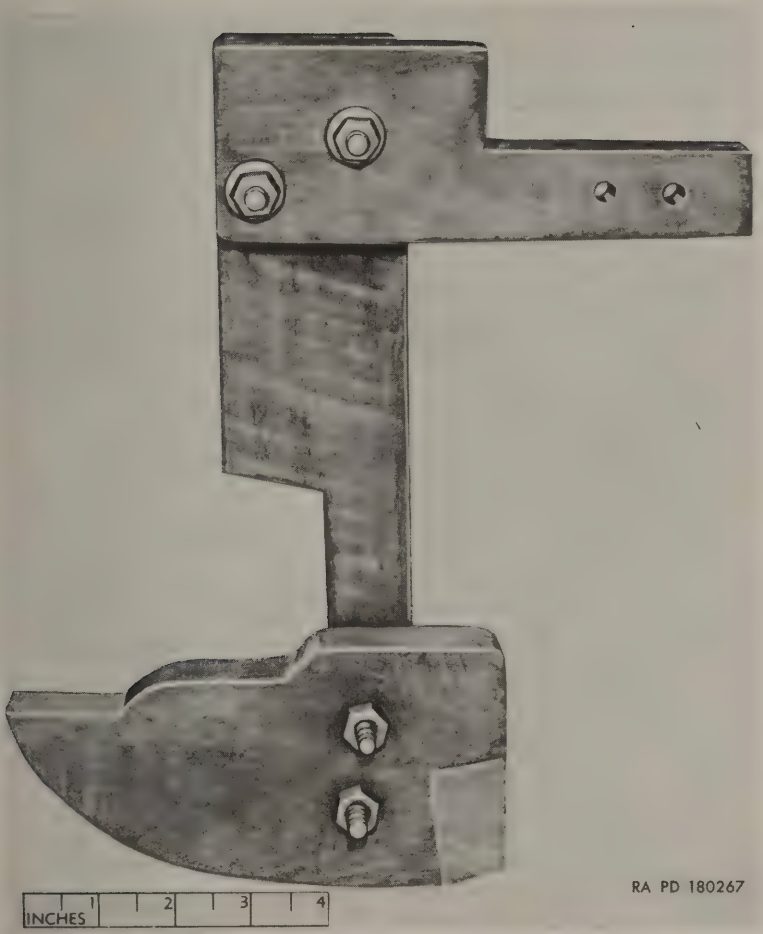



*Figure 42. Improvised telescope cradle.*

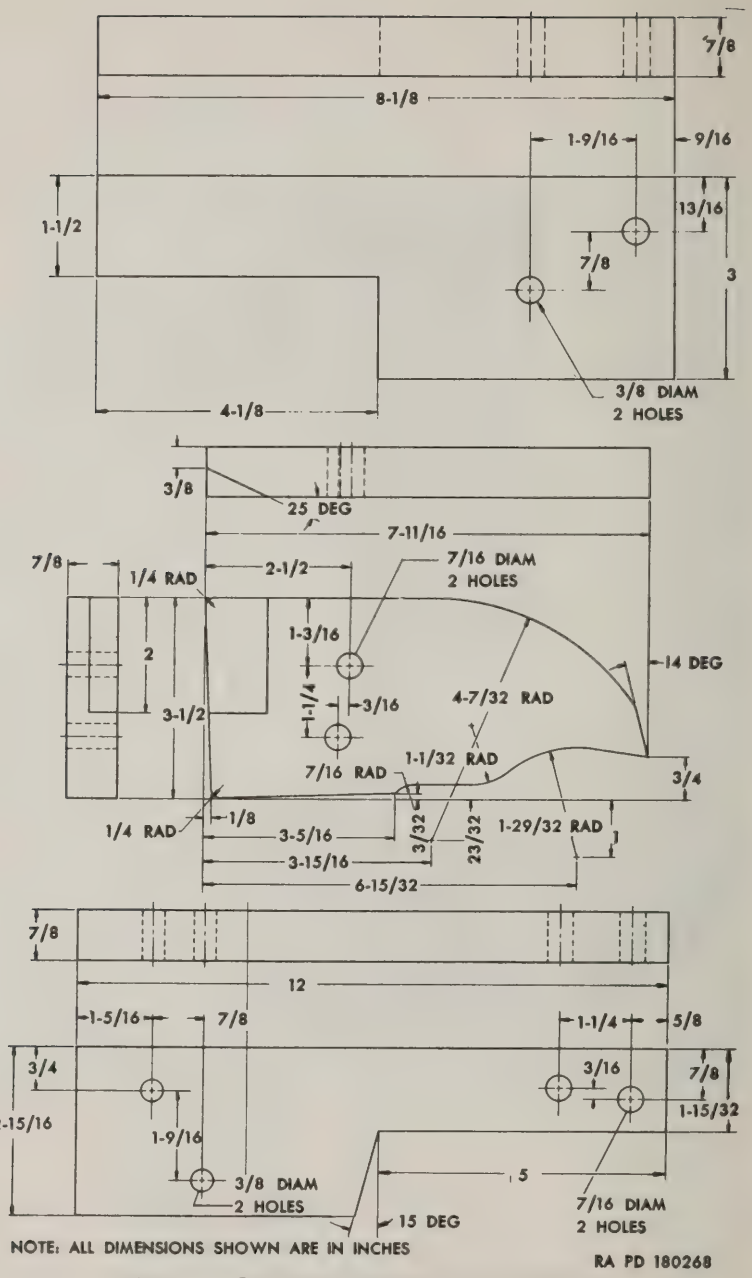



*Figure 43. Improvised telescope cradle dimensions.*

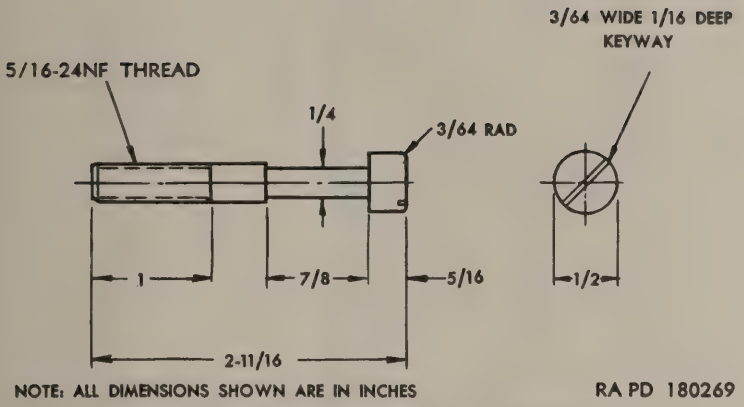



*Figure 44. Improvised holding screw 7662083.*

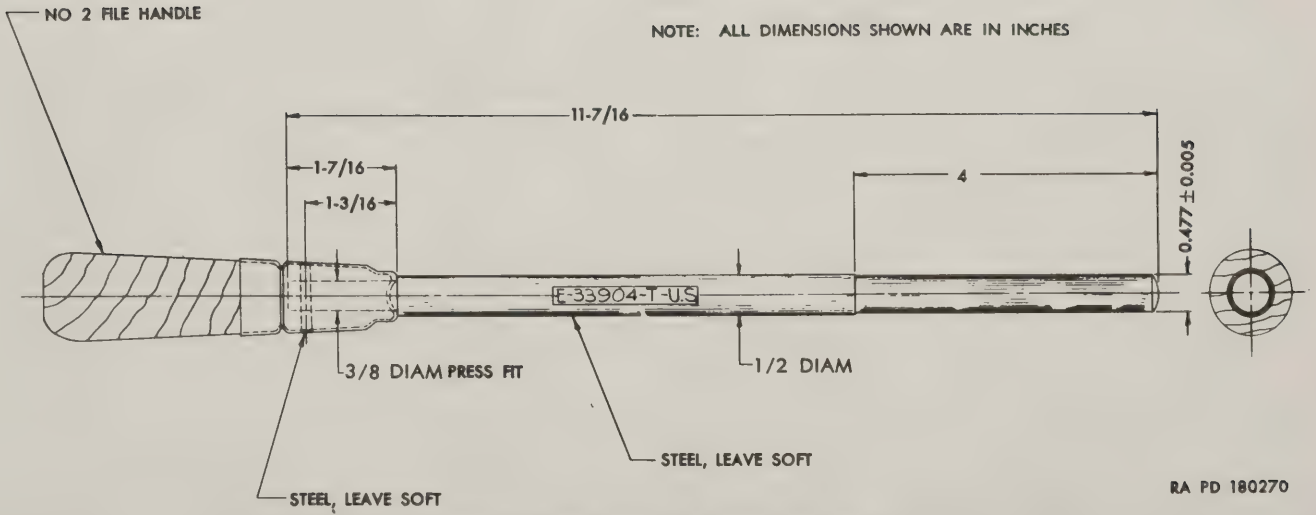



*Figure 45. Improvised bar wrench, 0.477 inch.*

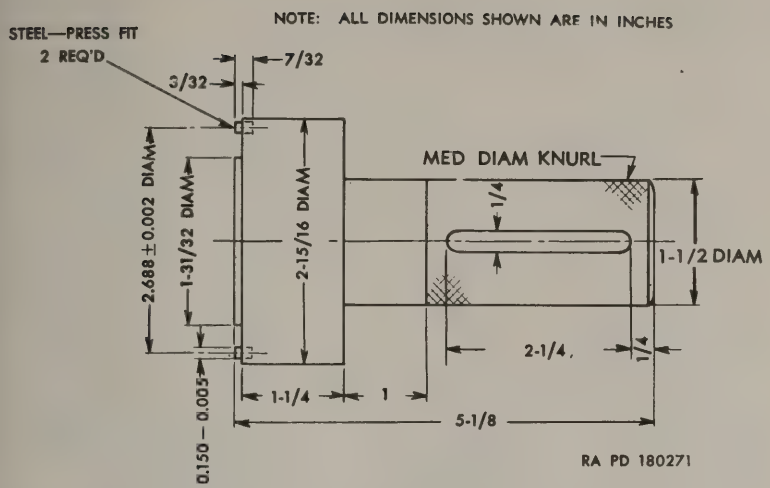



*Figure 46. Improvised cell assembly wrench 7633137.*

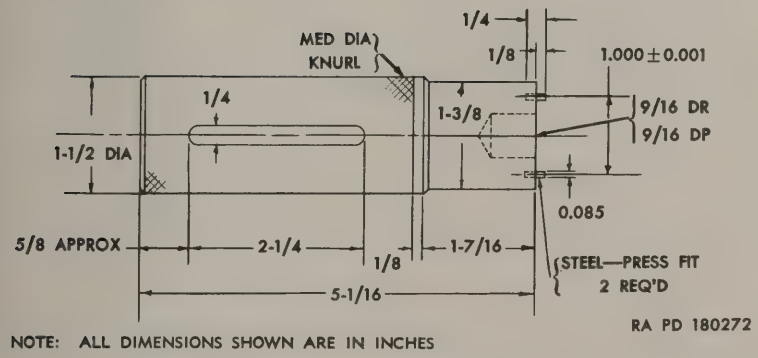
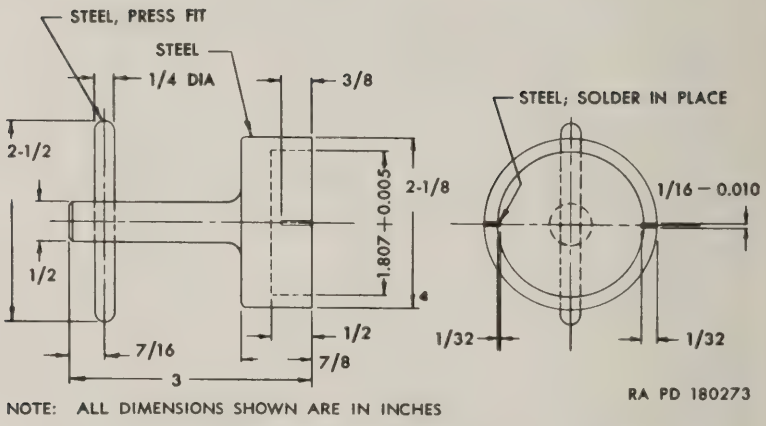



*Figure 47. Improvised desiccation valve wrench.*




NOTE: ALL DIMENSIONS SHOWN ARE IN INCHES

*Figure 48. Improvised hook spanner wrench, 2⅛ inch.*

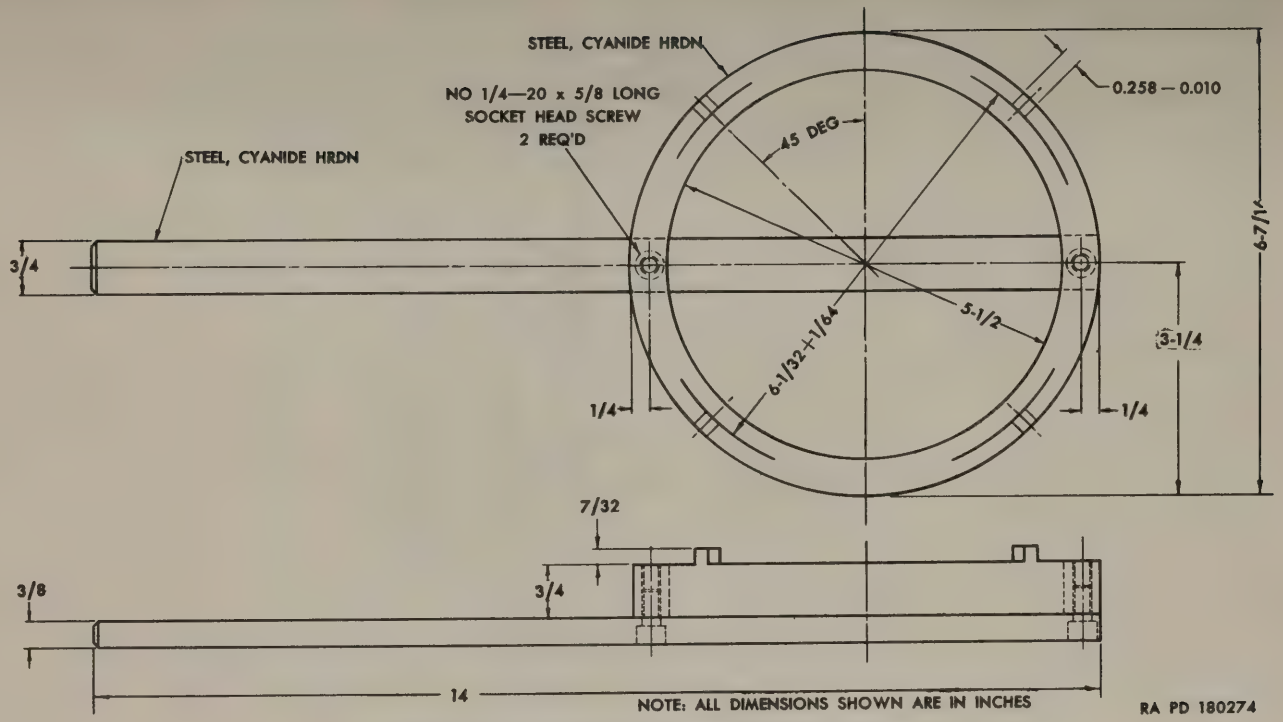



*Figure 49. Improvised hook spanner wrench, 6 1/16 inch.*

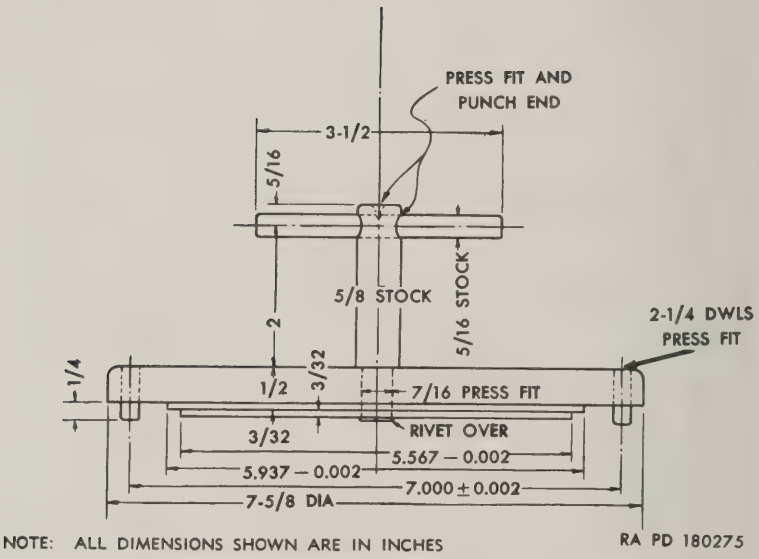



*Figure 50. Improvised main bearing wrench.*

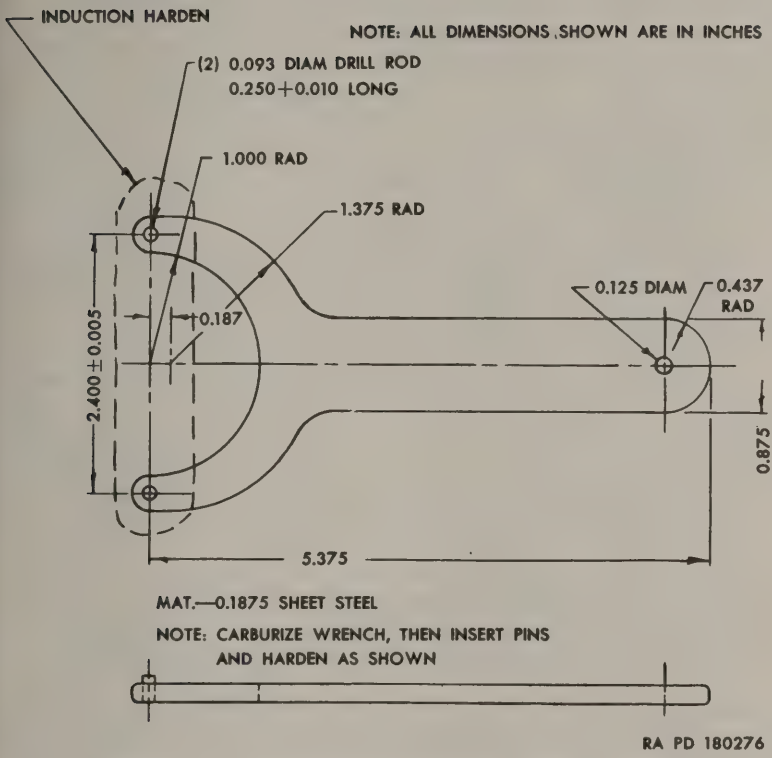



*Figure 51. Improvised pin-type spanner wrench, 2.4 inch.*

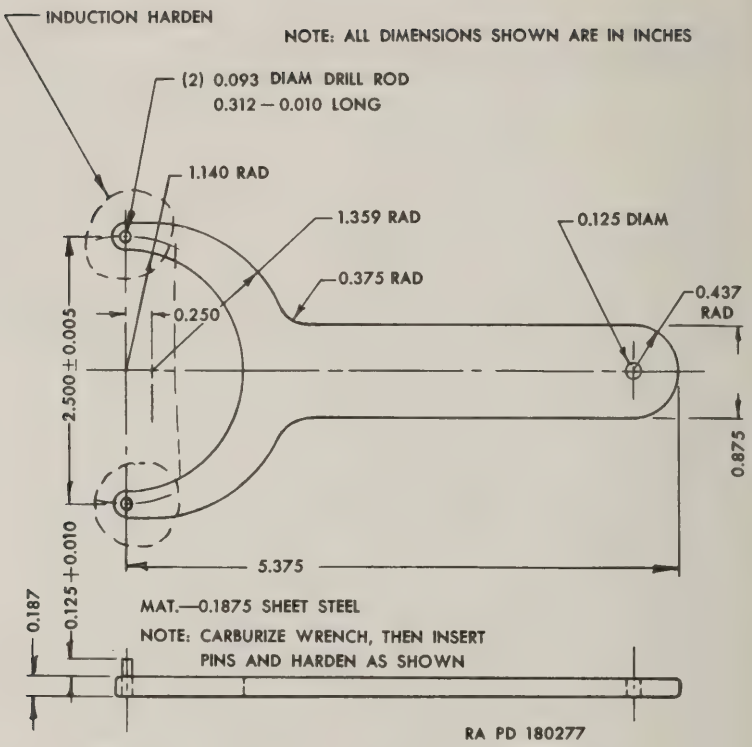



*Figure 52. Improvised pin-type spanner wrench, 2.5 inch.*

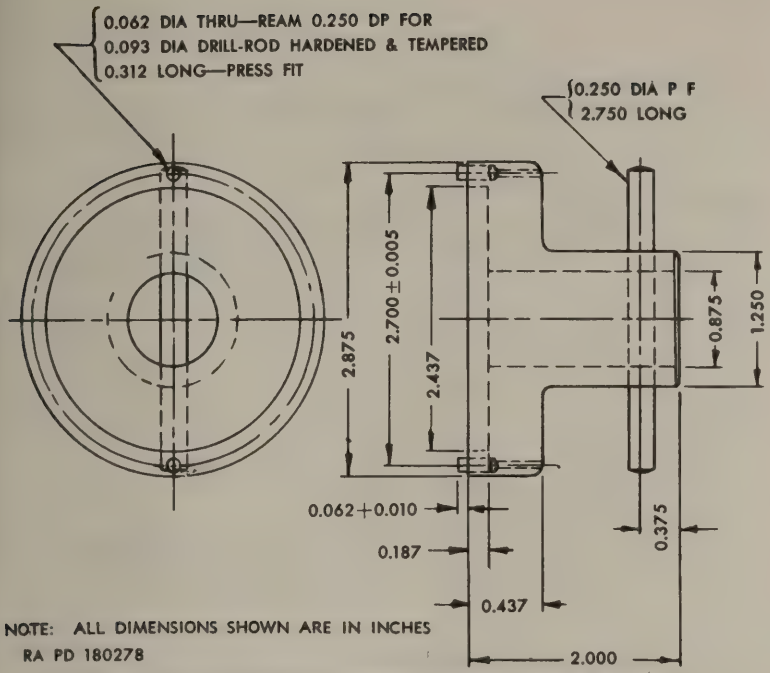



*Figure 53. Improvised pin-type spanner wrench, 2.7 inch.*

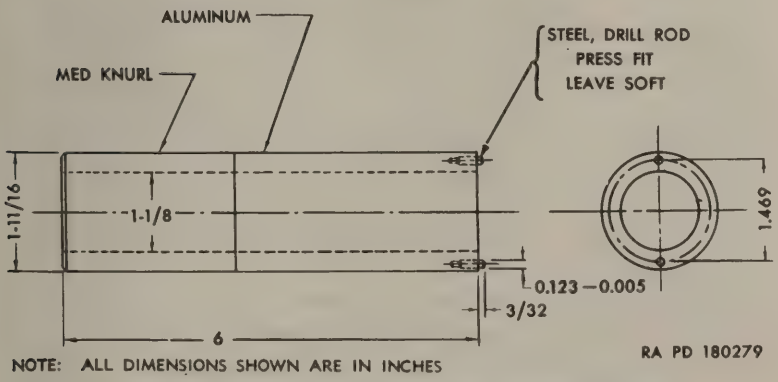



*Figure 54. Improvised pin-type spanner wrench, $1^{11}/_{16}$ inch.*

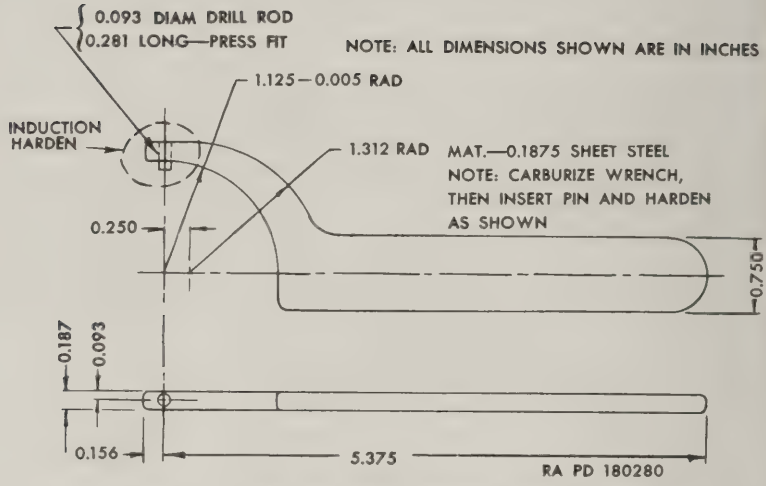



*Figure 55. Improvised single pin-type spanner wrench.*

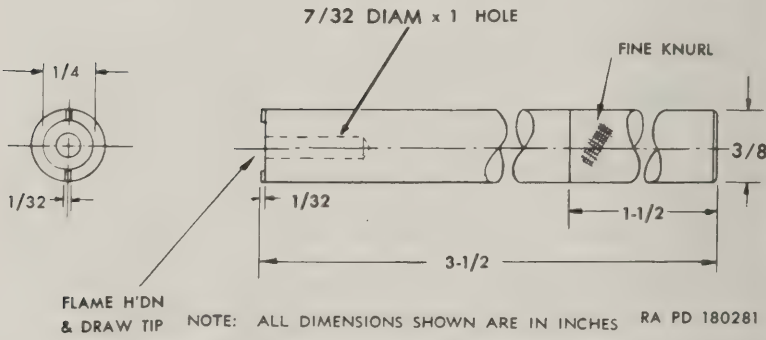



*Figure 56. Improvised tubular wrench, 3/8 inch.*

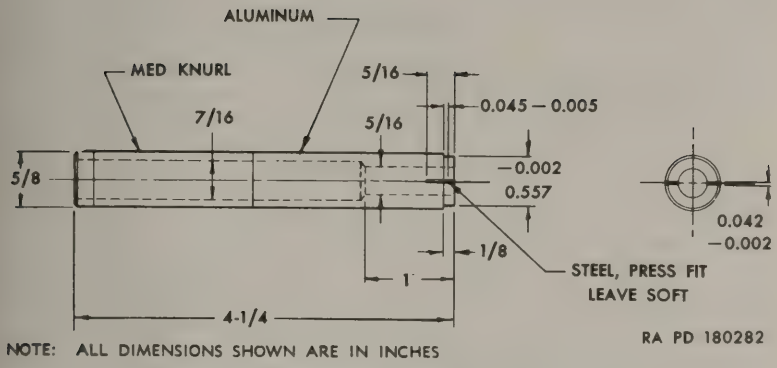



*Figure 57. Improvised tubular wrench, 5/8 inch.*

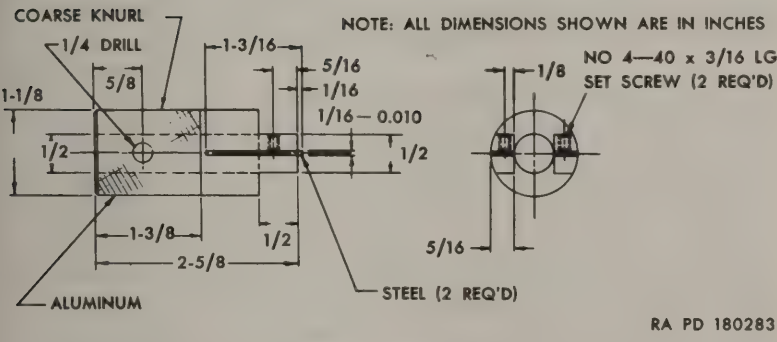



*Figure 58. Improvised tubular wrench, 1⅛ inch.*

# CHAPTER 3

# INSPECTION

## Section I. GENERAL

### 39. Scope

This chapter provides specific instructions for the technical inspections by ordnance maintenance personnel of range finder M12 or T41 either in the hands of troops or when received for repair in ordnance shops. It also defines the in-process inspection of materiel during repair and rebuild and the final inspection after repair and rebuild has been completed.

### 40. Purposes of Inspection

Inspection is primarily for the purpose of: determining the condition of an item, i. e., serviceable or unserviceable; recognizing conditions which would cause failure; assuring proper application of maintenance policies at prescribed levels; and determining the ability of a unit to accomplish its maintenance and supply missions.

### 41. Categories of Technical Inspections

In general, there are five categories of inspection performed by ordnance maintenance personnel:

*a. Overall Inspection.* This is an overall inspection performed periodically on *all* materiel in the hands of troops. It is also performed on materiel received for repair in field or depot maintenance shops. Upon completion of an inspection for serviceability, materiel will be declared either serviceable or unserviceable. This inspection may be limited in scope, such as an inspection of materiel in the hands of troops, or detailed in scope, such as an ordnance shop inspection. Detailed procedures are presented in paragraphs 43 through 47.

*b. Preembarkation Inspection.* This inspection is performed on materiel in the hands of troops alerted for oversea duty to insure that such materiel will not become unserviceable or worn out in a relatively short time. It prescribes a higher percentage of remaining usable life in serviceable materiel to meet a specific need beyond minimum serviceability.

*c. In-Process Inspection.* This inspection is performed by the repair technician and/or floor inspector in the process of repairing or rebuilding the materiel and its components. It insures that all parts conform to prescribed standards, that the workmanship is in accordance with approved methods and procedures, and that deficiencies not disclosed by the technical inspection are found and corrected. Detailed instructions are contained in chapter 7.

*d. Final Inspection.* This is an acceptance inspection performed by a final inspector, after repair and rebuild has been completed, to insure that the materiel is acceptable according to established standards. Detailed instructions are contained in chapter 8.

*e. Spot-Check Inspection.* This is a periodic overall inspection performed on only a percentage of the materiel in each unit to determine the adequacy and effectiveness of organizational and field maintenance.

### 42. Classification of Materiel

All ordnance materiel after inspection is classified as indicated in *a* and *b* below.

*a. Serviceable.* Serviceable property consists of all new or used supplies which are in condition for issue for the purpose intended and all supplies which can be placed in such condition through preissue tests or inspections, in-storage deprocessing, installation of accessories, correction of minor deficiencies which have developed since the item was last classified as serviceable, application of modification work orders for which parts are available, or assembly of available components.

*b. Unserviceable.* Unserviceable property consists of all supplies which are not serviceable (*a* above). The definition of unserviceable property is further broken down into the following subclassifications: property which is unserviceable but economically reparable, property which is unserviceable and not economically reparable.

## Section II. INSPECTION OF RANGE FINDER M12 OR T41 IN THE HANDS OF TROOPS

### 43. General

This section provides specific instructions for the technical inspection by ordnance maintenance personnel of range finder M12 or T41 in the hands of troops. Also, this section amplifies the general instructions contained in TM 9–1100 insofar as the instructions pertain to inspection of range finder M12. Personnel making these inspections will acquaint themselves with the malfunctions indicated in paragraph 53 which are the most common deficiencies of the range finder. In general, if the range finder is complete and performs its

intended function properly, if all modification work orders classified as urgent have been completed, and if all defects as disclosed by the inspection have been corrected, the range finders M12 and T41 may be considered serviceable.

## 44. Forms and Reports

Authorized forms and reports for technical inspections are prescribed in TM 9–1100. For additional authorized forms and reports for field and depot maintenance, refer to paragraph 3.

## 45. Inspection of Mechanical Components

*a. Completeness.* Examine the range finder carefully to be sure that all component parts are present. Particularly check for missing pins and screws, knobs, and nameplate.

*b. Appearance.* The appearance of the range finder will indicate its general condition and reflect the type of care and treatment it has received. Look for damaged, cracked, or dented surfaces, bent or broken parts, moisture and/or corrosion on outside of range finder, and other damage or misuse which might indicate a need for repair.

*c. Functioning of Mechanical Components.*

(1) *Mechanical components.* Mechanical components must operate smoothly without binding or rough motion. Parts must be free from grit and must be properly lubricated.

(2) *Backlash.*

(*a*) To check the backlash, move the elevation bore sight knob clockwise until the ballistic reticle becomes coincident with the horizontal line of the left target image.

(*b*) Record the elevation bore sight knob reading.

(*c*) Move the elevation bore sight knob counterclockwise until the ballistic reticle becomes coincident with the horizontal line of the left target image.

(*d*) The difference between these two readings must not exceed 0.2 mil.

(3) *Knob travel.* All knobs must have sufficient movement to cover the entire range of their corresponding scales.

(4) *Bore sight knobs.* The bore sighting knobs must function without undue irregularities, friction or looseness when in an unlocked position. The locking levers must hold the knobs firmly when in a locked position.

(5) *Halving knob.* Rotation of the halving knob will cause approximate equal movement above and below the fixed stereo pattern as viewed through the left and right eyepieces.

(6) *Other knobs.* The range knob, internal correction setting knob, ballistics correction knob, ammunition knob, interpupillary knob, and diopter adjustments must function without undue irregularities, friction or looseness.

(7) *Illumination.* When illuminated, the scales should respond as indicated on the nameplate; the brightness should be controlled by the rheostat knob.

*d. Sealing.* Inspect the reticle light window and the sealed and painted portions of the instrument to determine whether sealing is complete.

*e. Modification Work Orders.* All urgent modification work orders must have been applied. Check on application of all authorized modifications to see that no unauthorized alterations have been made, or that work beyond the authorized scope of the unit is being attempted. Check DA Pam 310–4 and the current modification work order files for any work orders promulgated.

*f. Nameplates, Scales, and Indexes.* Inspect scale numbers, divisions and indexes, and lettering on name, direction, and caution plates, to see that they are clearly defined and easily read.

*g. Paint and Finish.* Inspect for bare spots or damaged finish which expose base metal surfaces and lead to corrosion. Refer to TM 9–2851.

*h. Lubrication.* Bearings, sliding surfaces, hinge joint latches, and other movable parts will be clean, properly lubricated, and free from rust and other foreign matter. Check to see that the materiel is properly lubricated in accordance with paragraph 65.

*i. Cracks.* Plates, castings, and welds should be inspected for cracks and breaks.

*j. Spare Parts and Equipment.* Inspect the spare lamp housing (fig. 77) to see that it contains eight spare lamps.

*k. Ranging Accuracy.*

(1) Set the ICS knob, diopter and interpupillary settings to the operator's requirements.

(2) Range five times on a target of known distance, record the range readings and compare the medium range reading with the known distance of the target.

(3) The difference between the medium range reading and the known distance of the target will not be greater than two UOE.

*Note.*—One UOE is equivalent to 4.6 multiplied by the range squared ($4.6R^2$) where range is expressed in thousands of yards. Thus one UOE for 2,000 yards is equal to $4.6 \times 2^2$ or 18.4 yards.

## 46. Inspection of Optical Components

*a. Condition of Optional Elements.* Lenses, prisms, reticles, windows, etc., must be free from such scratches, pits, dirt, and chips as will interfere with or affect the optical performance of the range finder. Any breakdown or excessive discoloration of cement between elements of compound lenses which affects optical performance in the

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field will be cause for rejection of the instrument. Rejection is not to be based on the lack of reflection reducing coating for optical elements of instruments already in the field.

*b. Adjustment of Optical Elements.* Performance of the instrument must be such that image and reticle are properly defined and there is no evidence of parallax, double vision, or aberration. Refer to TM 9–2601.

(1) *Parallax of sighting reticle.* Provide a target of 1,500 ±200 yards and set the range scale to agree with the range chosen. Parallax in the right and left optical system at the optical axis (bore sight mark) should not exceed 0.1 mil (width of reticle line).

(2) *Parallax of ammunition and range scales.* Parallax between the index and range scale should not be more than one-half of the width of the index line and parallax between the index and ammunition scale should not be more than twice the width of the index line.

(3) *Scale transfer prism.* Sight through the left eyepiece of the range finder at a target of known range and indicate the range on the range scale. Position the bore sight cross on any point of this target, rotate the scale transfer prism and determine whether or not the bore sight cross falls on the same target within 0.5 mil when viewed through the right eyepiece.

(4) *Synchronization.* The vertical travel of the line of sight of the range finder must not vary by more than 0.5 mil from the vertical travel of the axis of the gun tube bore through maximum elevation and depression angles.

### 47. Inspection of Electrical Components

Electrical and power materiel will be inspected for evidence of circuit faults or possible sources of trouble as indicated by—

*a.* Components must be clean and free from grit.

*b.* High voltage arcs or short circuits.

*c.* Loose plugs and receptacles; loose connections in power cord plugs.

*d.* Electrical controls (knobs, dials, switches, etc.) must operate smoothly without binding or rough motion.

## Section III. ORDNANCE SHOP INSPECTION

### 48. General

Technical inspection performed by the ordnance repair shop upon receipt of materiel turned in for repair, determines the extent of repairs required, and provides the basis for requisitioning the parts, as-

semblies, or supplies necessary to accomplish the repairs. Often this inspection in the shop may be the same as that performed by inspectors in the field. It may disclose additional necessary repairs not indicated by the using organization.

### 49. Inspection

The inspection performed by the ordnance shop consists of: a check on the inspections performed in the hands of the troops; and determining additional defects not disclosed by the field inspection by performing a complete inspection, as indicated in paragraphs 384 through 412.

## Section IV. PREEMBARKATION INSPECTION

### 50. General

Inspection for outward appearance of the range finders M12 and T41 is of importance as well as inspection of mechanical condition. Where any doubt exists as to the utility of an assembly or of the range finder M12 or T41, the range finder must be replaced by a truly serviceable item. Equipment, when inspected, must approach new equipment standards of operation and appearance, and the workmanship and quality of the end product must reflect the highest standards obtainable. To assure that all items, insofar as practicable, possess original appearance, it is desired that items normally painted be repainted if the painted surfaces show signs of damage.

### 51. Inspection

*a. General.* The specifications, standards, and operations intended as a guide to insure satisfactory performance and acceptability of the range finder M12 or T41 must be followed as indicated in paragraphs 43 through 47.

*b. Modification Work Orders.* All modifications indicated in paragraph 45*e* other than those designated as optional must have been applied. For those modifications not yet accomplished, requisitions will be submitted to the appropriate agency for the necessary material to be forwarded to the unit when available.

# CHAPTER 4

# TROUBLESHOOTING

## 52. Purpose

Troubleshooting is the systematic isolation of defective components by means of symptoms, tests to determine the defective components, and application of remedies. The scope of the level of ordnance maintenance will govern the tests and remedies which may be applied.

## 53. Procedure

The troubleshooting procedure described in table III is one of determining, upon occurrence of malfunctions noted, the probable cause, then taking the necessary corrective action.

*Table III. Troubleshooting*

| Malfunction | Probable causes | Corrective action |
|---|---|---|
| Synchro torque transmitter inoperative. | Defective wiring | Check wiring with buzzer on circuit test instrument 7661530. |
| | Defective synchro torque transmitter. | Replace synchro torque transmitter (T41) (par. 240c). Replace synchro torque transmitter (M12) (par. 305.) |
| Reticle lamps do not light. | Defective lamp | Replace lamp, paragraphs 254 and 255. |
| | Defective wiring | Check for wiring (figs. 316 and 317) defect and repair. |
| | Incorrect voltage | With the connector in place in the rear of the range finder, turn on the master switch. If the stereo scales fail to illuminate, turn off the master switch and remove the connector. With a voltmeter see that the voltage is 24 volts up to the receptacle with the master switch on. |

*Table III. Troubleshooting*—Continued

| Malfunction | Probable causes | Corrective action |
|---|---|---|
| Reticle lamps do not light—Continued. | Defective direct breaker. | Failure to receive voltage indicates the need of a check of the circuit breakers in the turret accessories panel. Using an OHMMETER, test the continuity of circuit breaker. Reading should be 0 and if defective replace. A defective circuit breaker may indicate range finder wiring is defective. |
| | Defective wiring from turret accessories panel to range finder. | A continuity check may be necessary on the wiring from the turret accessories panel to the range finder. |
| | Contact point of lamp bent. | Straighten contact point or replace lamp. |
| Superelevation does not meet specific values. | Incorrect zero setting on ballistic correction knob. | Slip knob on shaft to correct zero (par. 394). |
| | Incorrect timing of gears. | Retime gear train (par. 379*b*). |
| Incorrect synchro transmitter positions. | Defective torque transmitter. | Replace torque transmitter (T41) (par. 240). Replace synchro torque transmitter (M12) (par. 305). |
| | Incorrect gear timing. | Retime gears (par. 379*b*). |
| Incorrect magnification. | Incorrect adjustment of erector lens assemblies. | Refocus erector lens assemblies (par. 392). |
| Incorrect range readings. | Incorrect deviation in compensator. | Replace compensator assembly (par. 363). |
| | Incorrect gears in compensator assembly. | Replace compensator assembly (par. 363). |
| Left line of sight not horizontal when elevation knob scale reads 3 mils. | Elevation knob scale has moved. | Reset elevation knob scale (par. 394*a*). |
| | Left end housing misalined on range finder. | Remount end housing (par. 383). |
| Left line of sight through boresight does not cross perpendicular to mounting keys. | Azimuth knob scale has has moved. | Reset knob azimuth scale (par. 394*c*). |
| Loss of reflected scales reticle or stereo patterns. | Damaged penta reflector in range finder. | Replace with serviceable penta reflector and adjust (par. 395). |
| Loss of image in either eyepiece. | Damaged penta reflector in end housing. | Replace end housing assembly (par. 383). |

*Table III. Troubleshooting*—Continued

| Malfunction | Probable causes | Corrective action |
|---|---|---|
| Right and left lines of sight not in coincidence in azimuth. | Incorrect range setting | Set range finder scale to correct range (par. 404). |
| Right and left lines of sight not in coincidence in elevation. | Right end housing assembly misalined. | Remount end housing assembly (par. 383). |
| | Right penta reflector misalined. | Adjust penta reflector (par. 395*b*). |
| Divergence out of tolerance. | Incorrect range setting | Set range finder scale to correct range (par. 404). |
| | 90° prisms in lower housing of telescope are out of alinement. | Readjust 90° prisms (par. 388*c*). |
| Divergence out of tolerance. | End housing assemblies not properly mounted. | Remount end housing assemblies (par. 383). |
| | 90° prisms in the lower housing of the telescope are out of alinement. | Readjust 90° prisms (par. 389). |
| Excessive parallax of ballistic reticle (range and ammunition scales). | Collimator lens alining assembly not properly focused. | Refocus collimator lens alining assembly (par. 397). |
| Excessive parallax of stereo reticles. | Stereo reticles not properly focused. | Refocus stereo reticles (par. 399). |
| Eyepiece diopter scales incorrect. | Diopter scales not correctly set. | Reset diopter scales (par. 385). |
| Target image tilted | Defective end housing | Replace end housing assembly (par. 383). |
| | Improper adjustment of prism support and prism differential assemblies. | Adjust prism support and prism differential assemblies (par. 391). |
| Ballistic reticle (range and ammunition scales) not horizontal. | Penta reflector of penta reflector assembly 7632811 not properly adjusted. | Adjust penta reflector on side where trouble occurs (pars. 394 and 395). |
| Stereo reticle image tilted. | Reticle cell assembly rotated. | Rotate reticle assembly to correct orientation (par. 400). |
| Bore sight reticle not in tolerance when transferred to other eyepiece. | Maladjusted partial reflector assemblies. | Adjust partial penta reflector (pars. 394 and 395). |
| Ammo knob movement not in relation to scale movement. | Ammo knob improperly set in relation to ammo scale. | Set ammo knob (pars. 379 and 406). |
| Interpupillary knob does not indicate correct eye distance. | Loose set screws | Adjust knob to correct setting. Secure set screws (par. 406). |
| | Knob incorrectly set. | |

# CHAPTER 5

# GENERAL MAINTENANCE PROCEDURES

## 54. General

*a.* Information and instructions contained herein are supplementary to instructions for the using organization contained in TM 9–718A.

*b.* This chapter contains general and specific maintenance instructions for the repair and rebuild of each major component. In the following sections, specific adjustments, and repair and rebuild procedures are described in order to restore each major component to a serviceable condition.

## 55. General Methods

*a. Tools.* Use only wrenches that fit snugly on parts. Tools that do not fit will fail or cause damage to the corners of bolt heads, nuts, screws, etc.

*b. Preparation for Repair Work.* When repairing instruments, clean the instrument body of oil, grease, and dirt to avoid soiling individual parts and cleaned subassemblies. If a replacement is indicated, salvage all serviceable parts from rejected subassemblies.

*c. Handling of Disassembled Parts.* A parts tray or suitable receptacle should be provided so that parts, as removed, can be placed in their respective positions in relation to the assembled range finder. Large assemblies should be placed on a clean, dry workbench and carefully placed so as to prevent loss or breakage. Always keep the relative position of parts until the range finder is completely assembled. This is especially important where the materiel is assembled by a technician other than the one who disassembled it. When parts are to remain disassembled for any length of time, keep bare metal surfaces clean and free from rust. Clean these surfaces with dry-cleaning solvent or volatile mineral spirits, wipe dry, and apply a light film of aircraft instrument lubricating oil. Before assembling parts wipe off this oil, clean the parts with dry-cleaning solvent or volatile mineral spirits, and lubricate in accordance with paragraph 65.

*d. Scribing Metal Parts.* As each part is removed, its exact position in relation to the assembly should be established by suitably scribed reference marks if it is necessary to return it to its exact original posi-

tion. Never scribe marks on threads or bearing surfaces. When removing mating gears, scribe each gear and assemble in the same position. A straightedge and a scriber should be used for scribing.

*e. Removal of Burs.* Burs should be removed with a stone or fine file. Where burs are apparent on closely fitted mating surfaces, they can be removed by lapping the surfaces with abrasive grade pumice. If burs appear on threaded surfaces, go over damaged threads with a thread chaser.

*f. Removal of Corrosion or Rust.* All metal parts should be inspected for corrosion or rust. If corrosion or rust are found, the part should be polished immediately with crocus cloth and coated with a light film of aircraft instrument lubricating oil.

## 56. Removal of Set Screws

*a. General.* Mechanical components are frequently locked in position by the use of set screws. Disassembly of components without removing these set screws is one of the greatest causes of damage to fire control instruments. It is, therefore, necessary, before the removal of any parts of the telescope mount, to determine the presence of set screws by reference to the pertinent disassembly instructions and illustrations.

*b. Removal of Undamaged Set Screws.* When a set screw is to be removed, it may be necessary to dig out or scrape off dirt or covering paint. A sharpened piece of hard wood or brass wire are good tools for this purpose. Do not use a jeweler's screwdriver as this action may damage both the screwdriver blade and the threads in the screwhole. When the head of the screw can be seen, insert a screwdriver of the proper size and remove the screw.

*c. Precautions.* If the screw will not back out when normal pressure is applied with the screwdriver, do not force it. It may have been sealed in position with orange shellac varnish or another fixing agent. If so, apply a few drops of alcohol to the screw head and allow it to soak for a few minutes. Again insert the screwdriver and exert a slight back and forth pressure. Repeat this process until the screw can be removed by normal pressure.

*d. Removal of Damaged Set Screws.*

(1) If the slot of a set screw below the surface is damaged and the screw is not too small, it may be possible to drill a small hole in it and remove it with a screw extractor. If the set screw is near the surface, it may be possible to slot it sufficiently with a swiss-pattern file or other sharp-pointed instrument, and remove it with a jeweler's screwdriver thus saving time that would be spent in drilling.

(2) If the set screw can not be removed as in (1) above, the best method, usually, is to drill out the set screw and tap the hole

for the next larger size set screw. If this is to be done, set up the part to be drilled in a firm position on a drill press, with the drill parallel to the set screw hole, and carefully drill out the screw. It is good practice to use the tap drill of the next larger screw which is to be used as a replacement.

(3) A set screw that can be turned but which does not back out indicates a stripped thread condition. It may be possible to back out the screw if the part held in place by the set screw can be turned enough to put slight stress on it, thus allowing those threads still undamaged to engage. It may then be possible to work the screw out of the hole.

## 57. Staking

Staking is a process employed to secure two parts together by striking one of the parts, adjacent to the part to be locked in position, with a center punch and hammer. This forces surface metal against the part, thereby locking it in position. Staking should be accomplished with as light taps of the hammer as possible but with a heavy enough blow to prick the work and bring the metal to the desired shape. Staking is frequently used to lock set screws in position.

## 58. Drilling and Tapping for Set Screws

Drilling and tapping of screw holes is sometimes necessary after an instrument has been adjusted. Drill and tap size must be determined by checking the dimensions of the screw in ORD 9 SNL F–356, Section 1. Whenever a hole is drilled and tapped, remove all burs and chips from the parts before final assembly. When drilling a shallow seating hole for a securing screw, use a drill slightly smaller than the inside diameter of the screw hole. Do not drill clear through the part in which the screw seat is being made. Just a touch of the drill will be sufficient. When the threads in the screw hole are damaged, tap with the proper sized tap.

## 59. Taper Pins

*a. Removal of Taper Pins.* To remove a taper pin, determine which is the smaller of the two ends. Usually, the larger end is identified by a "0." Mark the external part at the large end if it is not already so marked. Then remove the pin by one of the methods indicated in (1) and (2) below.

(1) If the small end of the pin is exposed, one sharp blow on that end of the pin with a soft hammer is all that is usually necessary.

(2) If the small end of the pin is below the surface, select a punch slightly smaller than that end. Use a straight pin punch, not a tapered one. Be sure to place the punch against the small end of the pin. Strike the punch with one sharp hammer

blow. Such a blow will usually remove the pin, whereas several haphazardly struck blows will damage it. Determine the size of the hammer according to the size of the job.

*b. Installation of Taper Pins.* Before securing two parts with a taper pin, always check the direction of the taper. Slip the pin loosely in the hole from either side. It should be driven into the side in which it enters more deeply. Failure to follow the practice of checking the direction of taper in the parts may cause damage to the parts when the pin is driven in and possibly make them unserviceable. A clean hole and a well-machined pin should fit together within one-sixteenth of an inch of the final position. If this is not the case, check the pin for burs and the hole for poor alinement of parts. When the pin is in place properly, one sharp tap on the pin with a brass hammer is all that is needed to drive it into its final position. If a brass hammer is not available, an ordinary hammer and a brass punch may be used.

*c. Preparation of New Parts To Receive Taper Pins.* A new part that is to be assembled to a shaft with a taper pin is drilled and reamed for the taper pin at assembly. The new part is already spotted to indicate the location where the part should be drilled prior to reaming. Several parts also have a tapped hole to accommodate a setscrew which can hold the part in its proper location on the shaft during the drilling and reaming operations. After drilling and reaming, the setscrews must be removed. The size of the reamer used is chosen in accordance with the size of the taper pin.

## 60. Removal of Retaining Rings and Cells

*a.* If the ring has been jammed beyond the point where it may be removed in the proper manner, it must be cut from the cell or tube. A thin, diamond point machinist chisel should be used to make three cuts, equidistant from each other, in the retaining ring to the depth of the thread in the cell or tube. Care should be taken to hit the chisel properly and with the right weight so as not to damage the optical elements, the tube, or the cell. If it is possible to drill the ring, it may assist in making the cuts. After cutting, the pieces of the ring can be removed by prying them loose from the threads of the cell or tube. Before reassembly is attempted, the thread of the cell or tube must be repaired with the proper thread chaser and a new retaining ring fitted.

*b.* The cells contained in the range finder are held by a retaining ring, and, after the ring is removed, they should slide out. If they do not, invert the instrument and tap it lightly in the area of the tube or cell with a rapping stick. The cell should then drop. If additional pressure is required, it should then be applied with a wooden dowel stick behind the cell. Care should be taken not to dent the instrument.

*c.* Dents, bent or broken parts, and damage to tubes and separators, should be repaired whenever possible. Parts should be replaced only

when their use would impair the functioning of the instrument. Dented tubes may be repaired by using a mandrel of solid stock with an outside diameter slightly less than the inside diameter of the tube. The mandrel is inserted in the tube to the damaged section. The mandrel is then clamped in a vise, and the tube is tapped with a soft mallet until the dent is pressed out and the tube returns to its proper shape.

## 61. Care of Optical Elements

*a. General.* Extreme care should be used when removing optical elements, since any slight damage to the optic will make it unserviceable.

*b. Removal of Lenses From Cells.* To remove lenses from cells with threaded retainers (fig. 59), remove the retaining ring set screws,

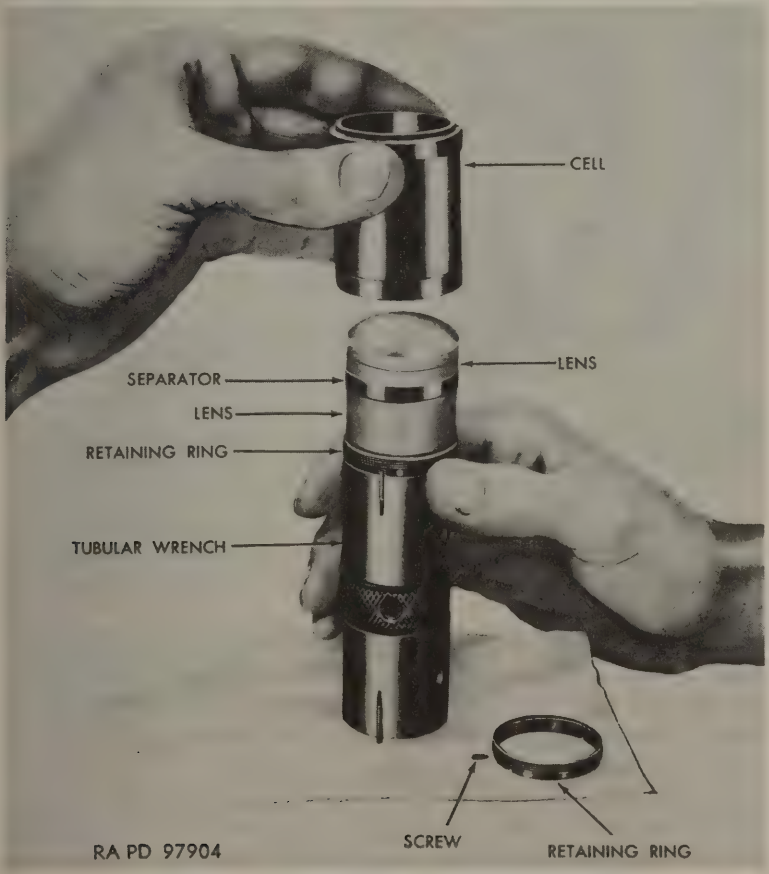


*Figure 59. Removing optical elements of a cell.*

fit the proper size tubular wrench to the retaining ring and proceed to loosen the ring. When the ring has made one revolution, turn the cell over and tap gently to allow the lens to drop onto the retaining ring. Maintain this inverted position while removing the ring; the lens will drop down evenly as the ring is removed. This will prevent cocking of the lens in the cell and subsequent fracturing or chipping of the lens. If the lens is sealed in the cell with either noncuring sealing compound or adhesive sealing compound, a shearing force is necessary to remove the lens. To greatly facilitate removal when noncuring sealing compound is used, apply heat to the cell. Heat the cell only enough to soften the sealing compound. Place the cell upon clear paper, back off the retaining ring several times, and utilizing several

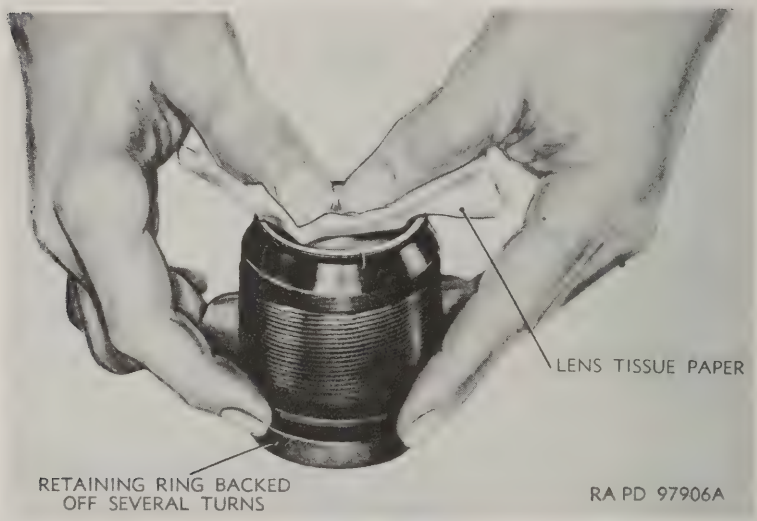


*Figure 60. Applying pressure to loosen sealed lens.*

folds of lens tissue to prevent smudging, apply finger pressure (fig. 60) to the top lens until the seal is broken. Finish the removal as described previously.

*c. Handling Optical Elements as Removed.* Never touch the polished surface of an optic. When optics are to be laid aside, each must be wrapped in a piece of lens tissue paper. When storing optics, always clean and wrap them completely in lens tissue paper.

*d. Marking of Optical Elements.*

(1) When removing lenses, each lens should be marked (fig. 61) on an unpolished surface to show which direction it faces, what assembly it is from, and what position it occupies within the instrument.

(2) Designate direction within instrument by an arrow directed toward the objective end of the instrument.

(3) Show sequence and position of the lens by marking an "E" for eyepiece, "O" for objective, etc., and marking number 1, 2, 3, etc. starting from the innermost component of the assembly and ending with the retaining ring.

(4) In the case of uncemented compound lenses, scribe lenses to retainers and to one another to insure alinement of axis to original position in assembly. Failure to do this may impair the efficiency of the system.

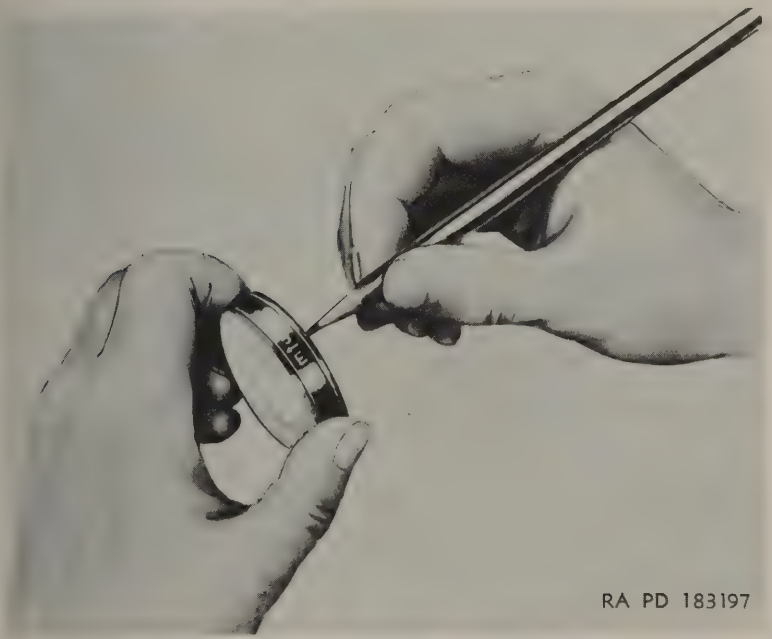


*Figure 61. Lens marking system.*

*e. Cementing Compound Optical Elements.* Refer to TM 9–1501 for correct procedures.

*f. Coated Optical Elements.* If the coating wears off, the optical elements should be coated at time of rebuild in accordance with TM 9–1501.

*g. Removal of Dirt Particles.* Prior to final installation into the telescope of assembled optical subassemblies, tap them with a length of rubber hose to dislodge dirt particles. Examine interior and disassemble to remove dirt particles if required.

## 62. Worm and Worm-Gear Mechanisms

*a. General.* The worm and worm gear principle is widely used in fire control instruments as a means of rotating an instrument in azimuth and in elevation. Figure 62 illustrates typical worm and worm-gear mechanisms. Note that the lateral movement of the worm is prevented by the worm ball cap which is threaded for adjustment, and that the worm is held in mesh by a spring and plunger arrangement on one end. Before proceeding with any maintenance work in connection with this type of mechanism, all maintenance work for the worm, as outlined in *b* below, must have been performed.

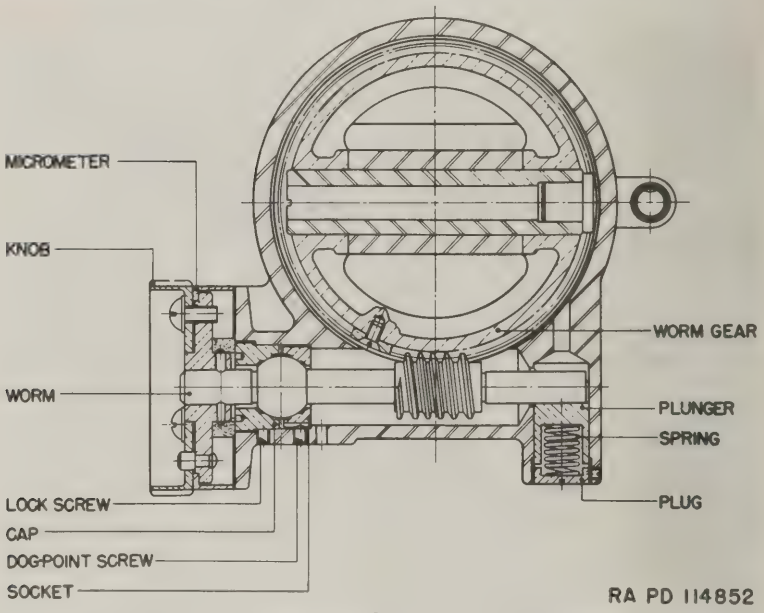


*Figure 62. Typical worm and worm-gear mechanism.*

*b. Maintenance of Worm.* For a worm to operate properly, it must be absolutely true and straight so as to prevent the worm from being thrown off center at each revolution and causing a binding movement in the worm and worm-gear mechanism. If such binding occurs, it is frequently due to a bend or, more often, several bends in the worm. In such cases, the entire worm should be replaced. It may sometimes, however, be necessary to try to locate and straighten these bends. This process involves much skill and the ability to select from a wide variety of methods those best suited to the particular condition found. No specific procedure can be outlined. Generally, the entire length of the worm must be continually tested during the restraightening process,

and straightened to a point where the worm thread will be no more than 0.001-inch off center when the worm is rotated in its bearings. Care must be taken to avoid damaging the worm thread or any of the bearing surfaces while straightening the worm.

*c. Maintenance of Ball.* The worm ball plays an important part in obtaining a smooth, nonbinding movement free from backlash, and the ball, therefore, must be perfectly round. An out-of-round ball provides a poor bearing surface and will cause binding in the throwout mechanism besides being a source of backlash trouble. To true an out-of-round ball (when a replacement part is not available) without removing an excess amount of metal, use a ball truing tool (fig. 63).

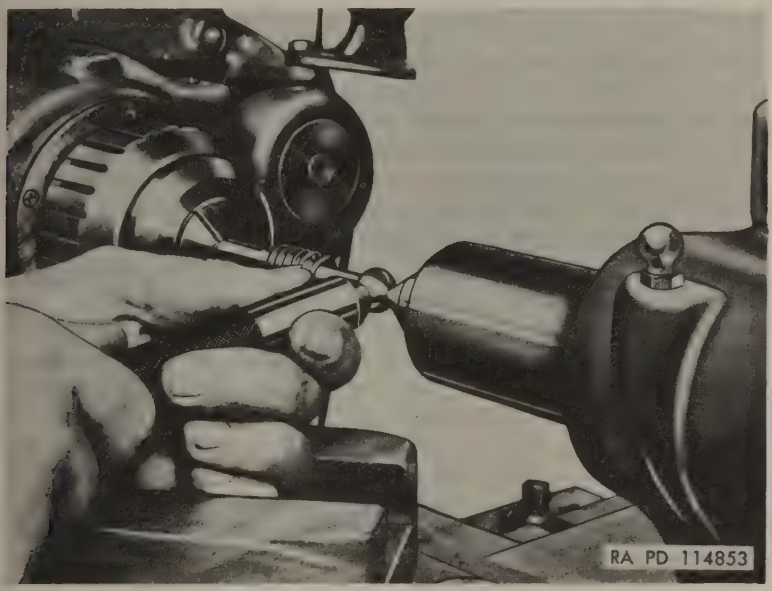


*Figure 63. Use of ball truing tool.*

*d. Fitting Plunger to Housing.* The plunger must fit in the housing without any side play. If it fits loosely, the worm will have side play which will appear as backlash on the micrometer dial. In order to facilitate handling of a new plunger, when fitting, select a piece of brass or steel rod, a little larger in diameter than the spring hole in the plunger, and turn a slight taper on the end of it. Then force the plunger tightly on the rod. The rod must not turn within the plunger. Lap the plunger in the housing so that the plunger will be free enough to move smoothly up and down when a slight finger pressure is exerted against it.

*e. Fitting Plunger to Worm.*

(1) The worm must fit in the semicircular bearing surface of the plunger without any side play. If side play is present, this will appear on the micrometer dial as backlash, as in the case of a loose fitting plunger. Before lapping in, relieve the center portion of the semicircular bearing. This is done so that the worm will wear itself in deeper, reducing the possibility of developing side play.

(2) Mount the worm in the housing and adjust the ball cap so that there will be no end play in the worm. Apply a thin coating of lapping compound (fine abrasive grade pumice) to the plunger's semicircular bearing surface and then insert the plunger into the housing. Insert the plunger spring. Screw in the plug until it is flush with the surface of the housing. Lap in by turning the worm a few turns in each direction. Remove the plunger and clean it in solvent so that the bearing surface can be observed. Lap until there is complete contact of the worm on the semicircular bearing surface of the plunger and worm and clean parts thoroughly. Assemble into housing and check for side play.

*f. Fitting Worm to Worm Gear.*

(1) Before lapping is started, always clean the parts thoroughly and examine the teeth for nicks, burs, and sharp edges. If a new worm is to be installed, place the worm in a lathe chuck, and with the lathe running at slow speed, file a slight radius on the corners of the worm thread. Whether a new or old worm is used, it is always best to check the gear mesh before lapping is started. Wipe a fine coat of Prussian blue on the worm thread and assemble the instrument. Turn the worm over the entire range of movement and then disassemble. Check for high spots, bottoming, etc. Scrape off the high spots. If an old worm is bottoming in the worm gear, set the worm up in a lathe and turn off about 0.010 inch from the outside diameter of the worm thread. Check to insure that the worm is not bottoming on the worm gear.

(2) If a new worm bottoms in the worm gear, then the worm-gear teeth are worn excessively and a new worm gear should be installed. When the bearing of a new worm on an old worm gear is checked, it may be found that the new worm is riding on the corners of the worm thread, because the old worm had a larger radius on the corners. Do not increase the radius on the new worm. Examine the corners of the worm-gear teeth. If there is a visible ridge, scrape it off with a 3-cornered scraper. If no ridge is visible, proceed to lap in the worm until an even, smooth movement is obtained

and the bearing is shown on the sides of the worm and worm-gear teeth. When lapping worm and gear, better results will be obtained by removing the spring behind the plunger and installing a solid plug. In this manner, any minute high spot which might be rolled over will be removed, thus increasing the perfection of the fit. After lapping is finished, place the worm in a lathe and increase the radius on the corners of the worm thread. This is done so that as the movement wears, the worm will move in without developing a bearing on the corners of the thread. A corner bearing will prevent the worm from moving into proper mesh, and backlash will develop.

## 63. Cleaning

*a. General.* Any special cleaning instructions required for specific mechanisms or parts are contained in the pertinent section. For general information regarding cleaning materials and services, refer to TM 9–850. General cleaning instructions for the range finder are indicated in (1) and (2) below.

(1) Use dry-cleaning solvent or volatile mineral spirits to clean or wash grease or oil from all metal parts of the telescope.

(2) Clean optical elements in a dust-free atmosphere if possible. Remove dust, lint, and other foreign matter by blowing with an air bulb or brushing lightly with a clean artist's camel's hair brush. Clean the optical element with alcohol or liquid soap, using lens tissue paper, starting at the center of the lens and cleaning outward with a circular motion. Repeat the operation several times if necessary and wipe with clean dry lens tissue paper for final finish. Use a jeweler's magnifying glass (loupe) for final inspection to make certain that no specks of dirt or dust remain. Good general rules to follow are listed in (*a*) through (*e*) below.

(*a*) For wiping optical parts, use only lens tissue paper, especially intended for cleaning optical glass. Use of cleaning cloths in the field is not permitted.

*Note.*—Under no circumstances should polishing liquids, pastes, or abrasives be used for polishing lenses and windows.

(*b*) Use alcohol sparingly on cemented lenses, as it will penetrate the cementing compound if allowed to run over the edge of the lens.

(*c*) Clean installed optical elements with a piece of clean lens tissue paper fastened to a length of doweling.

(*d*) Do not touch rubber to polished surfaces.

(*e*) In the case of coated optics, avoid repeated rubbing to prevent injury to the coating.

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*b. General Precautions in Cleaning.*

(1) Dry-cleaning solvent and volatile mineral spirits are inflammable and should not be used near an open flame. Fire extinguishers should be provided when this material is used. Use only in well ventilated places. In addition, they evaporate quickly and have a drying effect on the skin. If used without gloves they may cause cracks in the skin and, in the case of some individuals a mild skin irritation or inflammation.

(2) The use of diesel fuel oil, gasoline, or benzene (benzol) for cleaning is prohibited.

(3) Avoid getting petroleum products, such as dry-cleaning solvent or volatile mineral spirits on rubber parts, as the petroleum product will deteriorate the rubber.

## 64. Soldering of Electrical Connections

Before proceeding with soldering, all work to be soldered must be perfectly clean. Be sure that parts to be joined are heated to the proper fusion temperature before solder is applied. Always keep the work absolutely motionless while the solder is cooling. When soldering electrical connections, use rosin-flux core tin-lead solder. After soldering, wash the connection carefully with alcohol to remove all traces of rosin. Check to see that the solder is smooth and bright in appearance and shows no evidence of crystallization, overheating, or underheating. Sharp points or rough surfaces resulting from removal of the soldering iron before sufficient heating or overheating of the area are not acceptable. The applied solder must feather out to a thin edge, indicating proper flowing and sweating action. Insulation material subjected to heating during the soldering operation must not be damaged and fastened parts must not become loose.

## 65 Lubrication

*a. General.* Lubrication of the range finder should be performed very carefully as even a very slight amount of over lubrication often will render an item unfit for use. Excess lubricant may congeal and render close fitting parts inoperative. Lubricants for the range finder function also as rust preventives. It is important that they be applied carefully. It is essential that all parts to be lubricated be cleaned thoroughly prior to the application of the lubricant as corrosion may develop under grease if all foreign matter has not been removed. Specific lubrication instructions are contained in the assembly section.

*b. Grease.* For all parts of the instrument for which grease has been indicated in the pertinent assembly instructions, aircraft and instruments grease will be used. Grease will normally be applied to all

bearing or contact surfaces which move relative to one another and to all unprotected metal surfaces even though they are not working surfaces.

*c. Oil.* When a general purpose oil is required, use aircraft instrument lubricating oil. Oil will normally be used to treat bare metal surfaces when parts are to remain disassembled for any length of time. The only use of oil during assembly is to lubricate felt washers and strips by dipping.

## 66. Precautions Prior to Bonding and/or Sealing

*a. Inspection of Parts.*

(1) Polished surfaces of optical elements whether they are glass, methyl-methacrylate or any other light transmitting material which are part of the optical system must be properly cleaned (par. 63) prior to sealing.

(2) Checkmating parts for proper fit and clearance.

(3) Where possible, examine the void formed to receive the sealer to insure against obstruction which will retard the flow of the sealing compound.

(4) Check the contact points between the component parts to make sure there is unrestricted sealing and freedom from strain through assembly of the integral parts.

(5) Where the compound is used as a cushion, check the assembly to assure sufficient clearance between parts for complete coverage with the compound. This prevents chipping and other types of failure induced by mechanical shock or temperature variations.

*b. Clean Surfaces.*

(1) Surfaces must be thoroughly cleaned before the bonding or sealing operation, since the presence of a film of grease or oil reduces adhesion.

(2) Cleaning procedures (par. 63), approved for component parts of fire control instruments, should be sufficient to produce a surface conducive to a properly sealed joint.

(3) If nonadherence of the compound to metals is experienced clean the surfaces with alcohol.

*c. Assemble Parts.*

(1) Assemble the parts to be bonded or sealed with great care.

(2) The operator must assure himself that the parts are in such a relative position that the injection of the compound will not create internal strain in any of the parts of the assembly or the assembly as a whole.

(3) It is necessary, where the compound is a mechanical binder, that the assembly be made carefully to insure proper positioning of the parts by holding them in a predetermined posi-

tion while injecting the compound. Once the compound is cured, mechanical and optical alinement is restricted by the adhesive characteristics and immobilization of the bond.

## 67. Bonding and Sealing with Adhesive Sealing Compound

*a. Mixing Sealing Compound With Accelerator.*

(1) Adhesive sealing compound 52–C–3257–220 is supplied in a two-compartment metal container. One compartment contains sealing compound and the other compartment accelerator. Mix the accelerator with sealing compound in a ratio of 8 : 1, respectively by weight.

(2) These proportions must be maintained for proper curing, regardless of the quantity being mixed.

(3) Mix only the quantity that can be used in a working period of approximately 2 hours at 80° F.

*b. Application of Sealing Compound.*

(1) The compound is applied depending on the available equipment, the area to be filled and the design or type of joint.

(2) Bonding and sealing is done with the hand-operated injection gun J022–7648117, using adapters to fit the injection ports. Select an adapter having the proper orifice and the size and length of thread which is appropriate for the drilled and tapped injection port and the void to be filled. Always select a tip that presents the least resistance to the flow of the compound. This includes the shortest tip with the largest usable orifice.

(3) Prevent air pockets from forming when loading the hand gun with compound to insure an even flow into the sealing and bonding cavities.

(4) Remove screws from all plugged holes, if they have been inserted to maintain cleanliness, to permit unrestricted injection of the compound and prevent air blocks.

(5) Insert the injection tip or adapter of the hand gun into the injection port of the instrument. Screw in the tip until it shoulders against the body for additional strength.

***Caution:*** The end of the adapter should not protrude into the cavity. Check the length of the threaded tip to insure against its touching and displacing instrument parts inside the cover. Do not subject the threaded tip to the weight of the mechanical hand gun since it may snap off of the adapter, distort the parts, or cause shifting and misalinements.

(6) Apply sufficient pressure to the plunger to start the compound moving into the area to be filled. Continue filling the cavity with the compound until it begins to appear in ad-

jacent port holes. These holes are used for pressure relief or for progressive filling. Use only sufficient pressure to keep the mass moving.

***Caution:*** Do not use excessive pressure in an effort to fill a large area without transferring the injection tip. This will create unnecessary strain and may cause displacement of parts.

*c. Curing of Sealing Compound.*

(1) Place the sealed instrument or assembly, without plugging screws or caps, in an oven within two hours before partial sealing is observed at the injection ports.

(2) The curing time is from 4 to 8 hours at a temperature of 165° to 175° F.

*Note.*—This is not the oven temperature but the temperature of the item being processed. The oven temperature should not exceed 170° F.

(3) During the curing, some compound may be expelled through the injection ports. This excess compound must be removed.

(4) Adhesive sealing compound can also be cured by allowing the instrument to stay at a room temperature of approximately 80° F. from 72 to 96 hours. This is an alternate procedure to the accelerated heat method and can be applied when planning allocates the time.

## 68. Sealing with Noncuring Sealing Compound (for Static Seals)

*a. Sealing by Injection or Hand.* There are two general methods for applying noncuring sealing compound 52–C–3258–500, to seal fire control instruments indicated in (1) and (2) below.

(1) Sealing by injection where the design of the instrument includes the necessary ports and grooves to accommodate the injection adapters.

(2) Sealing by hand where the sealing compound has been prepared by extruding a threadlike form referred to as "spaghetti."

*b. Application of Sealing Compound.*

(1) *Injection sealing.*

(*a*) The compound is applied depending on the available equipment, the area to be filled and the design or type of joint.

(*b*) Sealing may be done with the hydraulic injection gun J022–7648134, using adapters to fit the injection ports. Approximately 1,500 pounds per square inch is required to extrude the compound from the adapter. Select an adapter having the proper orifice and the size and length of thread

which is appropriate for the drilled and tapped injection port and the void to be filled. Always select a tip that presents the least resistance to the flow of the compound. This includes the shortest tip with the largest usable orifice.

(*c*) Prevent air pockets from forming when loading the injection gun with compound to insure an even flow into the sealing cavities.

(*d*) Remove screws from all plugged holes, if they have been inserted to maintain cleanliness, to permit unrestricted injection of the compound and prevent air blocks.

*Figure 64. Applying "spaghetti" in a cell.*

(*e*) Insert the injection tip or adapter of the gun into the injection port of the instrument. Screw in the tip until it shoulders against the body for additional strength.

***Caution:*** The end of the adapter should not protrude into the cavity. Check the length of the threaded tip to insure against its touching and displacing instrument parts inside the cover. Do not subject the threaded tip to the weight of the gun since it may snap off of the adapter, distort the parts or cause shifting and misalinements.

(*f*) Fill the cavity with the compound until it begins to appear in adjacent port holes. These holes are used for pressure relief or for progressive filling. Use only sufficient pressure to keep the mass moving.

***Caution:*** Do not use excessive pressure in an effort to fill a large area without transferring the injection tip. This will create unnecessary strain and may cause displacement of parts.

(2) *Hand application.*

(*a*) To form the "spaghetti," extrude the noncuring sealing compound through the proper size adapter of the hydraulic injection gun. The adapter size is determined by the area to be filled by the sealing compound.

(*b*) The "spaghetti" is then cut to the proper length required to completely circle the part being sealed and packed into the crevice (fig. 64) provided for the sealing compound.

(*c*) Do not use an overabundance of sealing compound because in the final cleaning of the instrument, all excess sealing compound must be removed.

## 69. Sealing with Noncuring Sealing Compound (for Rotary Seals)

*a.* Noncuring sealing compound 52–C–3258–505, is applied depending on the available equipment, the area to be filled and the design or type of joint.

*b.* Sealing may be done with the hand operated injection gun J022–7648117, using adapters to fit the injection ports. Select an adapter having the proper orifice and the size and length of thread which is appropriate for the drilled and tapping injection port and the void to be filled. Always select a tip that presents the least resistance to the flow of the compound. This includes the shortest tip with the largest usable orifice.

*c.* Prevent air pockets from forming when loading the hand gun with compound to insure an even flow into the sealing and bonding cavities.

*d.* Remove screws from all plugged holes, if they have been inserted to maintain cleanliness, to permit unrestricted injection of the compound and prevent air blocks.

*e.* Insert the injection tip or adapter of the hand gun into the injection port of the instrument. Screw in the tip until it shoulders against the body for additional strength.

***Caution:*** The end of the adapter should not protrude into the cavity. Check the length of the threaded tip to insure against its touching and displacing instrument parts inside the cover. Do not subject the threaded tip to the weight of the mechanical hand gun since it may snap off the adapter, distort the parts or cause shifting and misalinements.

*f.* Apply sufficient pressure to the plunger to start the compound moving into the area to be filled. Continue filling the cavity with the compound until it begins to appear in adjacent port holes. These

holes are used for pressure relief or for progressive filling. Use only sufficient pressure to keep the mass moving.

***Caution:*** Do not use excessive pressure in an effort to fill a large area without transferring the injection tip. This will create unnecessary strain and may cause displacement of parts.

## 70. Painting

Paint all exposed surfaces so that the equipment will have the appearance of a new item. Refer to TM 9–2851 for detailed information on painting.

## 71. Scales

Any scale, plate, or index which has become illegible should be cleaned and filled with graduation filler. To apply graduation filler, remove all paint or filler from the perforations or graduations with a scriber or other appropriate tool. Be sure that all the edges are left sharp and distinct. Apply the filler by pressing it into the perforations or graduations with the fingers, and wipe off the excess filler with a clean cloth. Care must be taken to see that the color will match the original color.

# CHAPTER 6

# REMOVAL AND DISASSEMBLY

## Section I. GENERAL

### 72. Scope

This chapter contains general and specific instructions for the removal of the range finder from the on-carriage position, the removal of all major assemblies from the instrument, and a complete disassembly of all assemblies in their proper sequence.

### 73. Procedure

When complete repair and rebuild of the range finder is performed, it is necessary to remove and disassemble all component parts of the range finder as described in detail in this chapter. When shop operations are confined to repair only, then it is necessary to remove only those components that require attention. In those cases, references should be made to the pertinent paragraphs in this chapter.

## Section II. REMOVAL OF RANGE FINDER FROM ON-CARRIAGE POSITION

### 74. Disconnect Range Finder from Ballistic Drive

*Note.*—Before removing the range finder, turn the master switch in the driver's compartment to the off position to disconnect the electrical circuits.

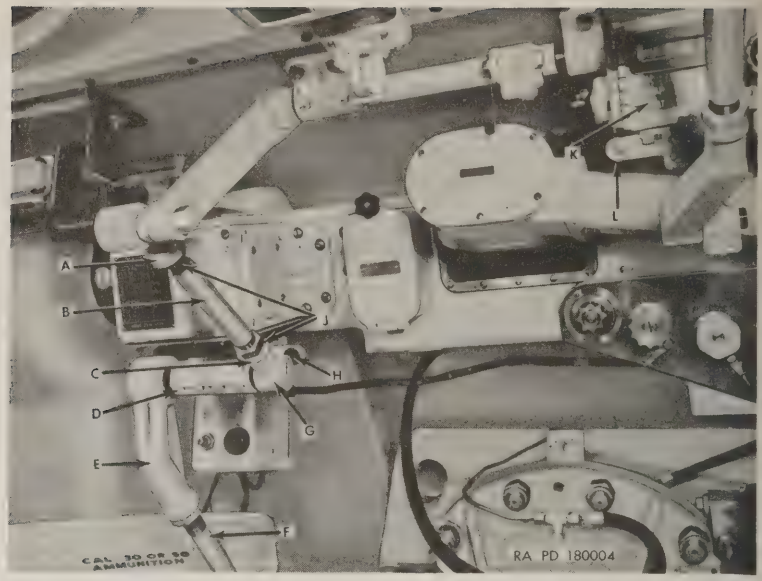
*a.* Break the wire seals (C, fig. 65) on the lower connector (G) of the range finder and the ballistic drive connector.

*b.* Loosen the two lock nuts (J) that secure the connector rod (B) to the connectors and unscrew the rod from the ballistic drive connector (A) leaving the rod attached to the range finder.

### 75. Disconnect Range Finder from Gun Trunnion

Break the seals on the upper connector (E, fig. 65) of the range finder and the gun trunnion.

*Note.*—Do not use the connector rods on the replacement range finder as the connectors have been set in manufacture for each range finder.




A—Ballistic drive connector
B—Conector rod
C—Wire seal
D—Cap screws
E—Upper connector
F—Trunnion connector rod
G—Lower connector
H—Level vial
J—Lock nut
K—Ballistic drive
L—Level vial

*Figure 65. Fire control equipment installed in tank.*

## 76. Disconnect Commander's Periscope T35 from Ballistic Drive

Loosen the four socket-head screws (Q, fig. 66) on the base assembly (P) of the ballistic drive and remove the connector (S) from the base assembly. Tie the detached connector and rod to the tank turret roof to prevent damage.

## 77. Removal of Gunner's Periscope Splash Plate and Periscope Head Assembly

*a.* Unscrew the two serrated knobs (H, fig. 66) that secure the splash plate (G) to the gunner's periscope mount (N). Pull out the plate with an outward and downward movement to remove it from the periscope mount.

*b.* Unscrew as far as possible the two wing nuts (fig. 71) that secure the periscope head to the periscope mount.

*c.* Grasp the periscope head and disconnect the periscope coupling (F, fig. 66) from the ballistic drive (C) by actuating the coupling

A—Ballistic drive bearing
B—Screw
C—Ballistic drive
D—Instrument light T22
E—Commander's periscope connector rod
F—Periscope coupling
G—Splash plate
H—Serrated knob
J—Periscope eyepiece
K—Holding screws
L—Range knob
M—Gunner's periscope T35 body assembly
N—Gunner's periscope mount
P—Base assembly
Q—Socket-head screws
R—Stud
S—Connector
T—Cover assembly

*Figure 66. Fire control equipment installed in tank.*

elevating lever; then pull the head outward. When the head is clear of the mounting pins, apply a downward pressure to remove the head from the mount.

## 78. Removal of Gunner's Periscope Body Assembly

*a.* Pull the jack plug from the three prong receptacle in the base of the periscope mount.

*b.* Remove the instrument light M36, sliding the lamp bracket from the dovetailed slide located on the periscope body above the eyepiece.

*c.* Remove the four screws that hold the periscope body assembly (M, fig. 66) to the periscope mount and pull the body assembly from the locating pins in the mount.

## 79. Removal of Ballistic Drive

*a.* Pull the power lead from the bayonet socket in the instrument light T22 (D, fig. 66). This light is fixed to the right end bearing of the ballistic drive.

*b.* Detach the power lead from the upper receptacle of the cover assembly of the ballistic drive.

*c.* Unscrew the ten screws (B) that hold the ballistic drive (C) to the turret cover plate and remove the ballistic drive.

## 80. Removal of Turret Caps

Unscrew the socket head bolts (fig. 67) that secure the turret caps to the tank turret. Remove the caps from the turret.

***Caution:*** The caps are heavy and should not be allowed to rest on the end housings.

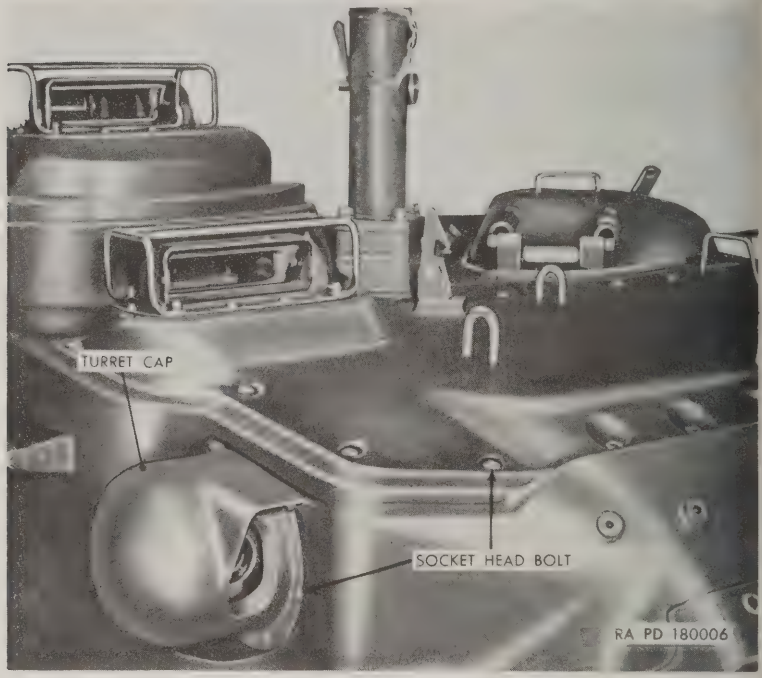



*Figure 67. Turret cap installed on tank.*

## 81. Removal of the Sealing Rings

Gently tap, from the inside of the tank, the two sealing rings (fig. 68) from around the range finder end housing assembly until they can be pulled free with the fingers.

## 82. Removal of Range Finder End Housing Assembly

Loosen, but do not remove, the larger of the two socket-head cap screws holding the key in the range finder end housing assembly. The key has been pulled tight and it may be necessary to tap the screw gently to dislodge the key. Use the torque wrench (fig. 69) to remove the six hex-head bolts holding the end housing assembly to the range finder. Remove the end housing assembly from the range finder.

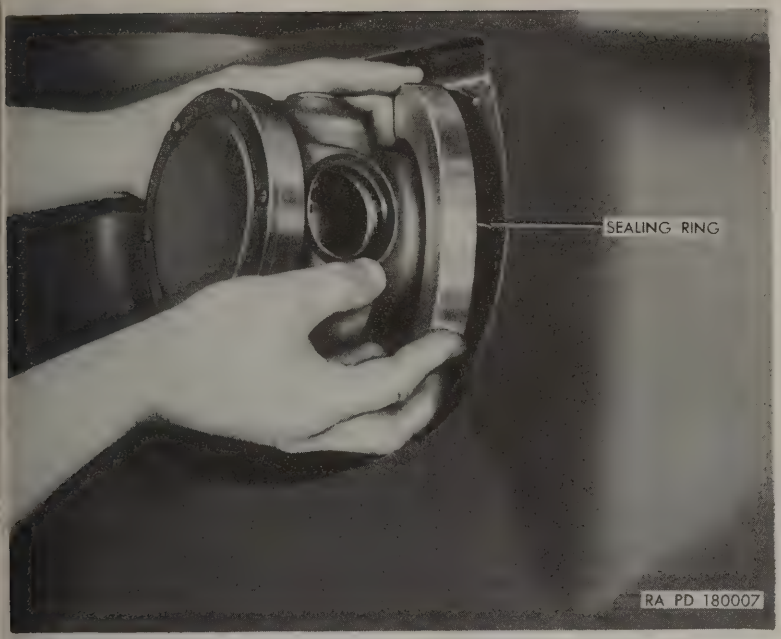



*Figure 68. Removal of sealing ring.*

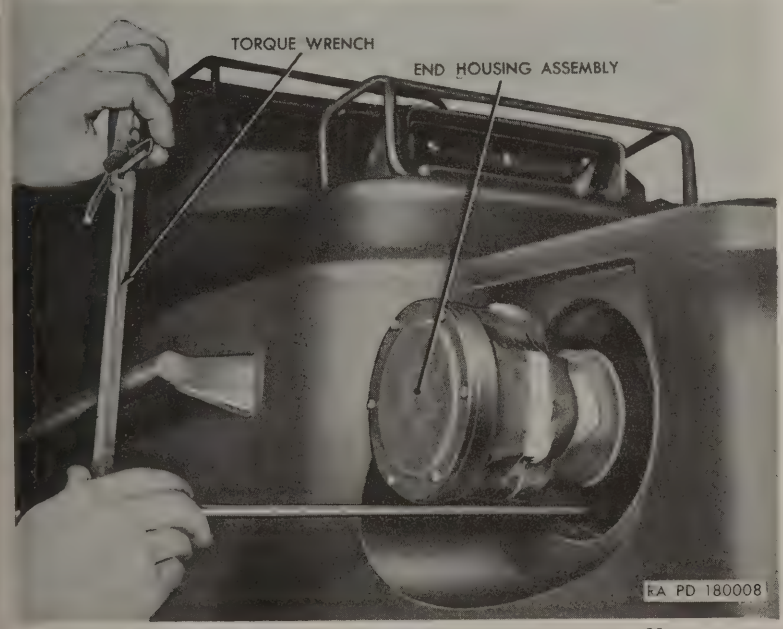



*Figure 69. Removal of rangefinder end housing assembly.*

## 83. Removal of Turret Cover Plate and Affixed Range Finder from the Tank Turret

*a.* Remove the 26 socket-head bolts (fig. 67) holding the turret cover plate to the turret.

*Note.*—Unscrew the lock nut and detach the plug from the receptacle in the range finder.

To raise the turret cover plate from the tank turret, use two short cables attached to the front lifting eyes and a longer cable to the rear lifting eye. This will compensate for the added weight of the range

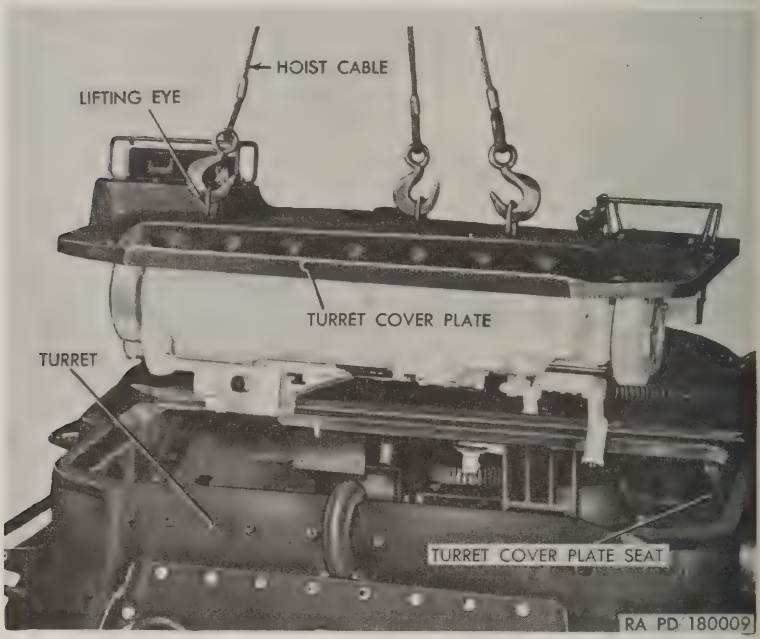



*Figure 70. Removal of turret cover plate and affixed range finder from tank turret.*

finder, which is bolted to the front section of the turret cover plate. Lift the plate (fig. 70) with the affixed range finder from the turret.

*b.* Before lowering the range finder to any working bench or table, attach one $4\frac{13}{16}$-inch long mounting post (fig. 71) and two $6\frac{3}{4}$-inch long mounting posts to the under side of the range finder. These support posts should always be available for attachment to the range finder when it is not assembled in the tank. They are listed in Ord 8 SNL F–356, section 1, for the range finder. Damage will occur if the range finder is permitted to rest on any surface without being supported by the posts. If the mounting posts are not available, they can be made from 1-inch diameter free cutting screw stock, cold rolled steel, listed in ORD 5 SNL H–10, using the following dimensions:

$4\frac{13}{16}$-inch long mounting post—overall length, $4\frac{13}{16}$ inch, length of post less threaded end, 4.31–0.01 inch, thread ½–20NF–2.
$6\frac{3}{4}$-inch long mounting post—overall length, $6\frac{3}{4}$ inch, length of post less threaded end, 6.25–0.01 inch, thread ½–20NF–2.

*c.* Lower the turret cover plate (fig. 71) over a work bench or table until the mounting posts barely touch.

***Caution:*** Do not permit the weight of the turret cover plate to be supported by the range finder, as this will result in distortion and damage of the range finder.

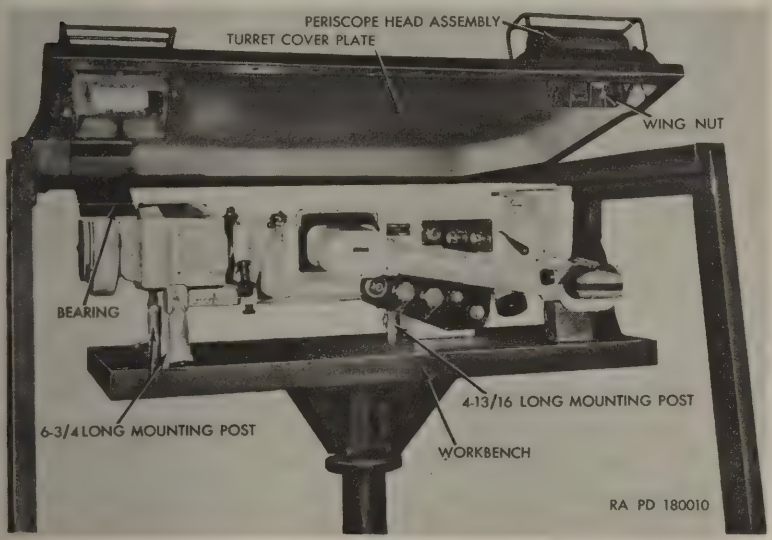



*Figure 71. Removal of turret cover plate from range finder.*

*d.* With the sling and hoist still supporting the weight of the turret cover plate, remove the eight holding bolts that secure the range finder bearings (fig. 71) to the mounting plate. The range finder now rests on the support posts and the cover plate can be lifted off and stored for reassembly.

## Section III. REMOVAL OF THE MAJOR ASSEMBLIES AND RELATED PARTS

### 84. Removal of End Housing Assembly

*a.* Loosen, but do not remove, the two socket-head cap screws (fig. 72). It may be necessary to tap the screw gently to dislodge the key.

*b.* Use torque wrench 41–W–3628–125 (fig. 10) to remove the six hex-head bolts holding the end housing to the range finder.

*c.* Remove the end housing assembly from the range finder.

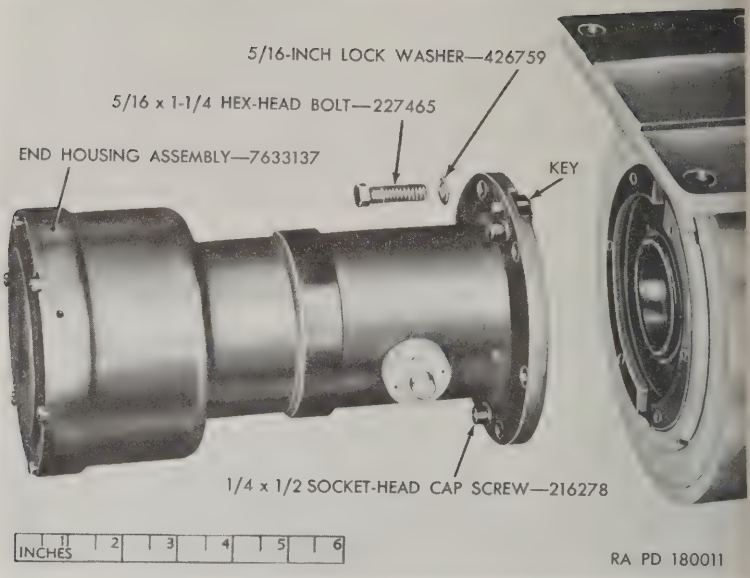

5/16-INCH LOCK WASHER—426759
5/16 x 1-1/4 HEX-HEAD BOLT—227465
END HOUSING ASSEMBLY—7633137
KEY
1/4 x 1/2 SOCKET-HEAD CAP SCREW—216278
INCHES 1 2 3 4 5 6
RA PD 180011

*Figure 72. Removal of end housing assembly.*

## 85. Removal of Main Housing Cover, Gasket, and Pipe Plug

*a.* Unscrew the five oval-head screws (fig. 73) that hold the upper section of the bellows rim to the housing cover.

*b.* Unscrew the 29 fillister-head screws and lock washers that hold the cover to the main housing and the ballistic cam housing. Pry off the cover and carefully extract the gasket from the cover groove to avoid damage to the gasket.

*c.* Pull out the two straight pins that locate the cover on the main housing and clean any sealing compound from main and cam housings, housing cover, bellows rim, and the gasket (par. 63).

*d.* Unscrew the pipe plug from cover, and clean the sealing compound from the threads of the cover and the plug.

## 86. Removal of 9 1/16-inch Long Rod, Lower Link Connector Assembly, and Upper Link Connector Assembly

*a.* Unscrew the $9\frac{1}{16}$-inch long rod (fig. 74) from lower link connector assembly.

*Note.*—The locking hex jam nut was loosened when the range finder was disengaged from the secondary fire control.

Unscrew both the hex jam nuts from the rod. Mark the rod to identify it for reassembly to the lower link connector assembly.

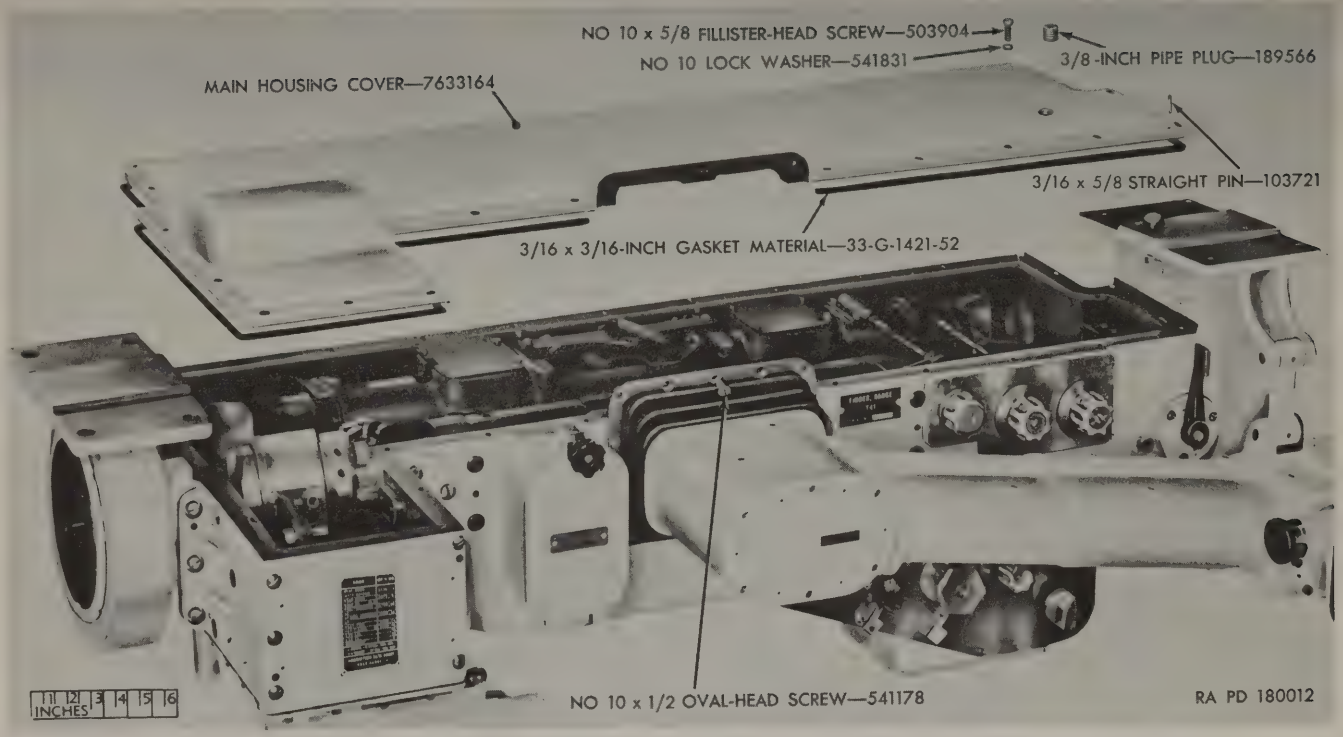

NO 10 x 5/8 FILLISTER-HEAD SCREW—503904
NO 10 LOCK WASHER—541831
3/8-INCH PIPE PLUG—189566
MAIN HOUSING COVER—7633164
3/16 x 5/8 STRAIGHT PIN—103721
3/16 x 3/16-INCH GASKET MATERIAL—33-G-1421-52
NO 10 x 1/2 OVAL-HEAD SCREW—541178
RA PD 180012
11 12 INCHES 3 4 5 6

*Figure 73. Removal of main housing cover, gasket, and pipe plug (T41 shown).*

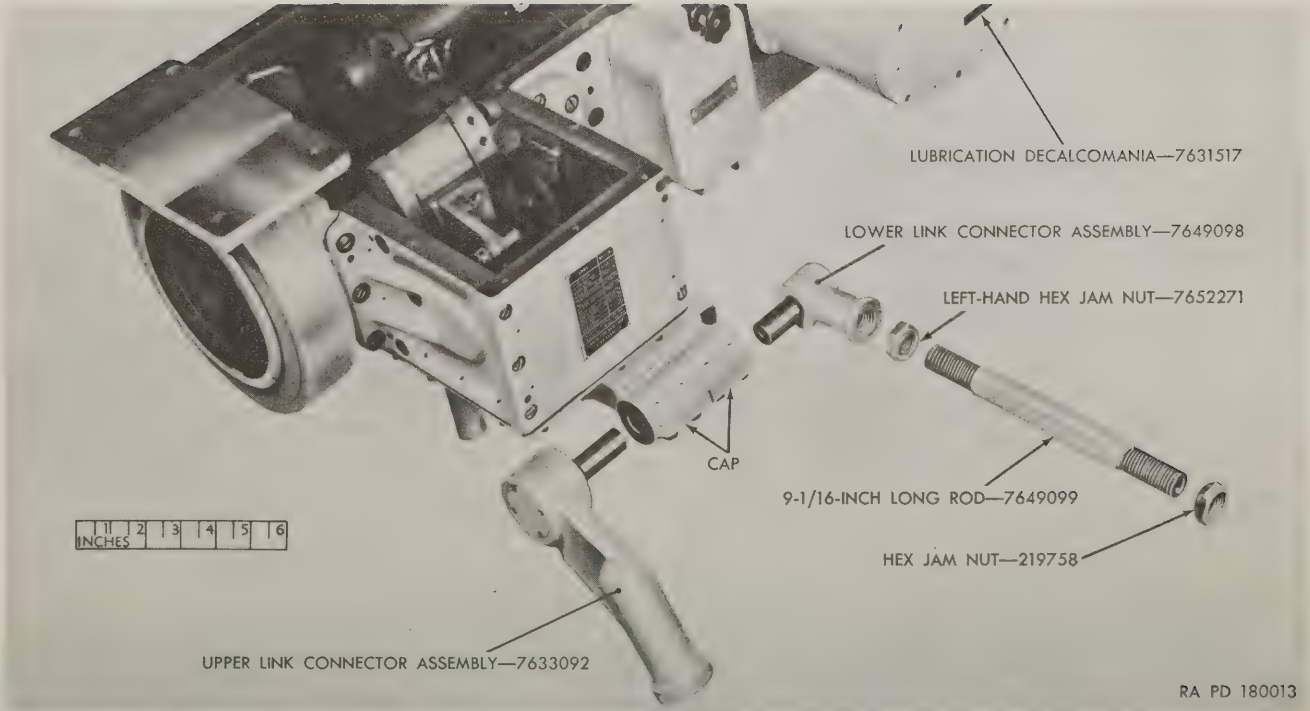



*Figure 74. Removal of 9 1/16-inch long rod, lower link connector assembly, and upper link connector assembly (T41 shown).*

*b.* Loosen the eight socket-head screws to free the cap and slide out both the upper and lower link connector assemblies from the cam housing support.

## 87. Removal of the Telescope Assembly

*a.* Drive the four taper pins (par. 59*a*) from the flexible shafts (fig. 75) to loosen the shafts from the telescope assembly and the collimator assembly.

*b.* Push both the shafts as far as possible toward the collimator assembly so that the shaft couplings will have a minimum contact with the telescope assembly.

*c.* Unscrew the remaining nine oval-head screws that hold the inner bellows rim and the bellows to main housing and pull the bellows away from the housing.

*d.* Remove the cup-point set screw from the eyepiece elevation link (par. 56), and drive out the straight pin that holds the lower housing of the telescope assembly to the link.

*e.* Unscrew the four socket-head screws that hold the bearings of the telescope assembly to the main housing.

*f.* Push the telescope assembly forward, slide it from the two straight pins, and lift the assembly from the main housing.

*g.* Pull the two straight pins from the main housing.

*h.* Clean any sealing compound from the rim, the bellows and the main housing (par. 63).

## 88. Removal of Upper Front Control Panel, Halving Knob Assembly, ICS Knob Assembly, and Ballistic Correction Knob Assembly

*a.* Unscrew the five oval-head screws (fig. 76) that hold the upper front control panel to the knob assemblies, and slide the panel over the knobs.

*b.* Unscrew the six fillister-head screws that hold the knob assemblies to the main housing, and slide the three knob assemblies from the straight pins. It may be necessary to pry off the assemblies due to the sealing compound between assemblies and housing.

*c.* Pull the six straight pins from the main housing, and clean the sealing compound from the main housing and assemblies (par. 63). Insert a brass wire into the sealing ports to clean the compound from the ports.

## 89. Removal of Spare Lamp Box Assembly

Unscrew the four fillister-head screws (fig. 77) and lock washers that secure the spare lamp box assembly to the main housing and pull the assembly from the main housing.

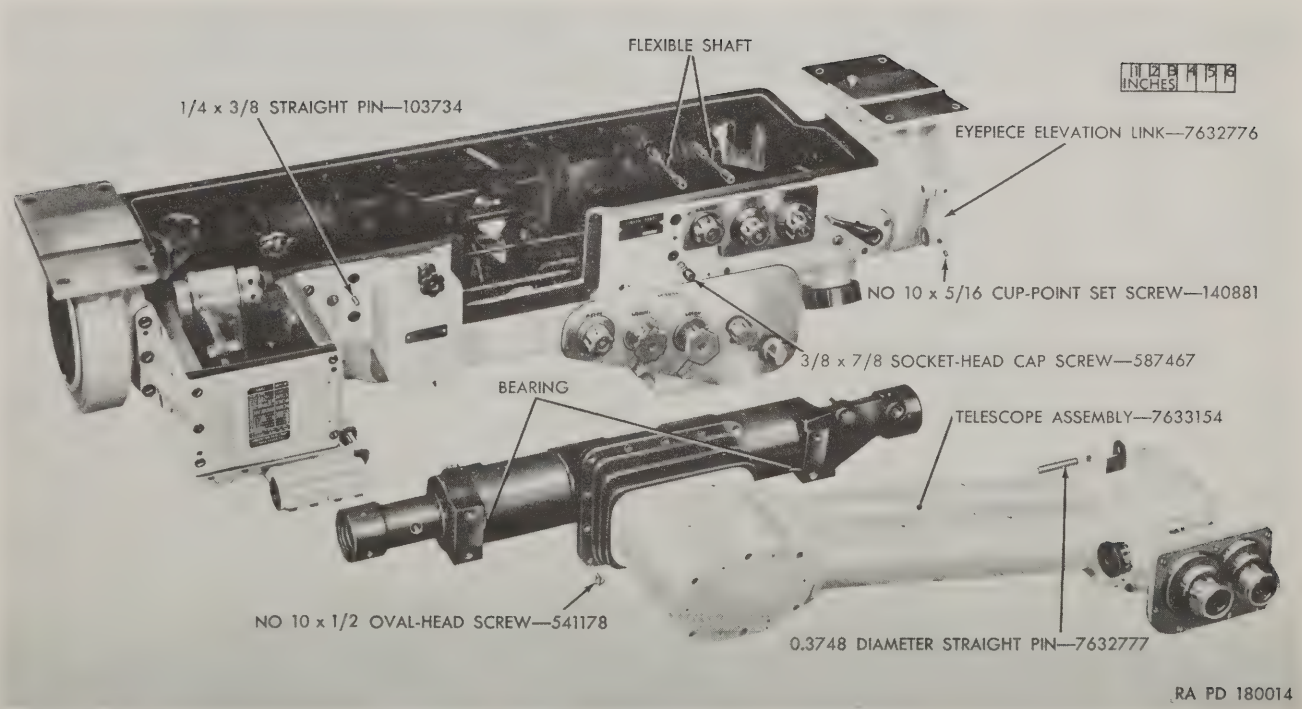



*Figure 75. Removal of telescope assembly (T41 shown).*

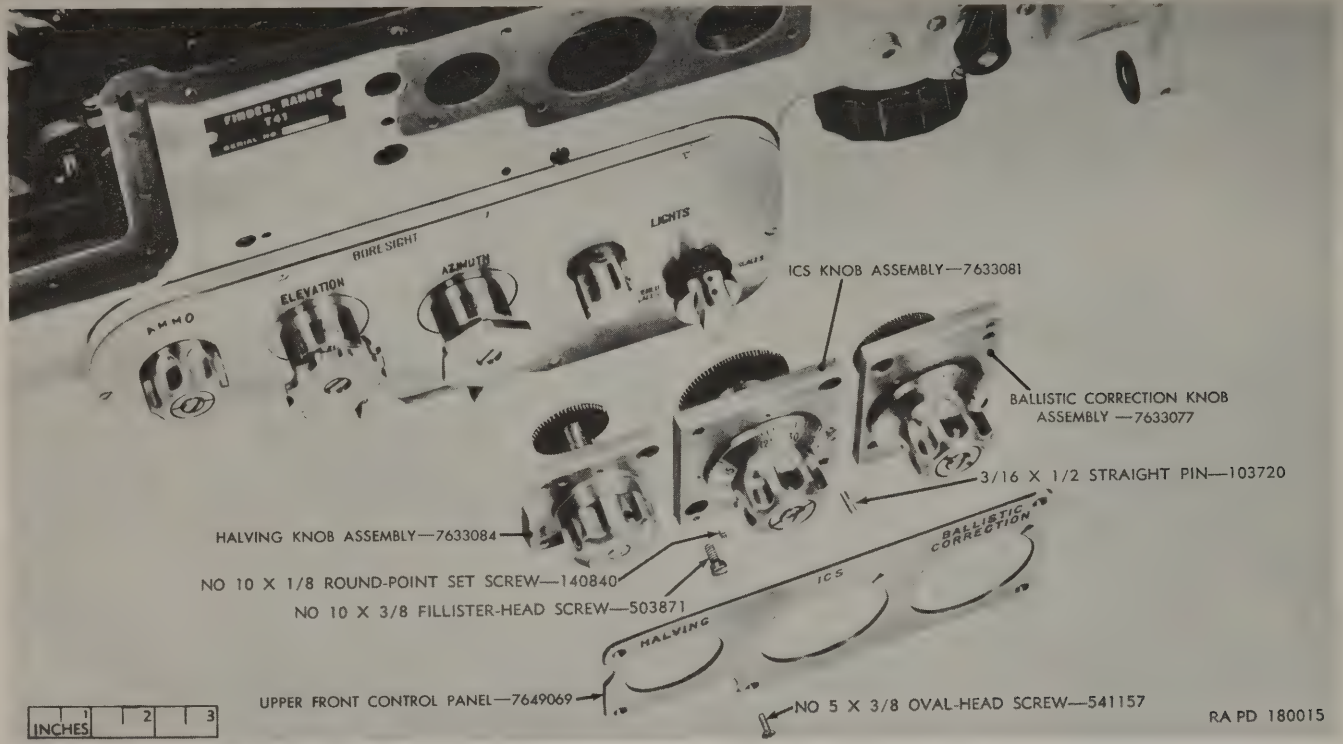



*Figure 76. Removal of upper front control panel, halving knob assembly, ICS knob assembly, and ballistic correction knob assembly.*

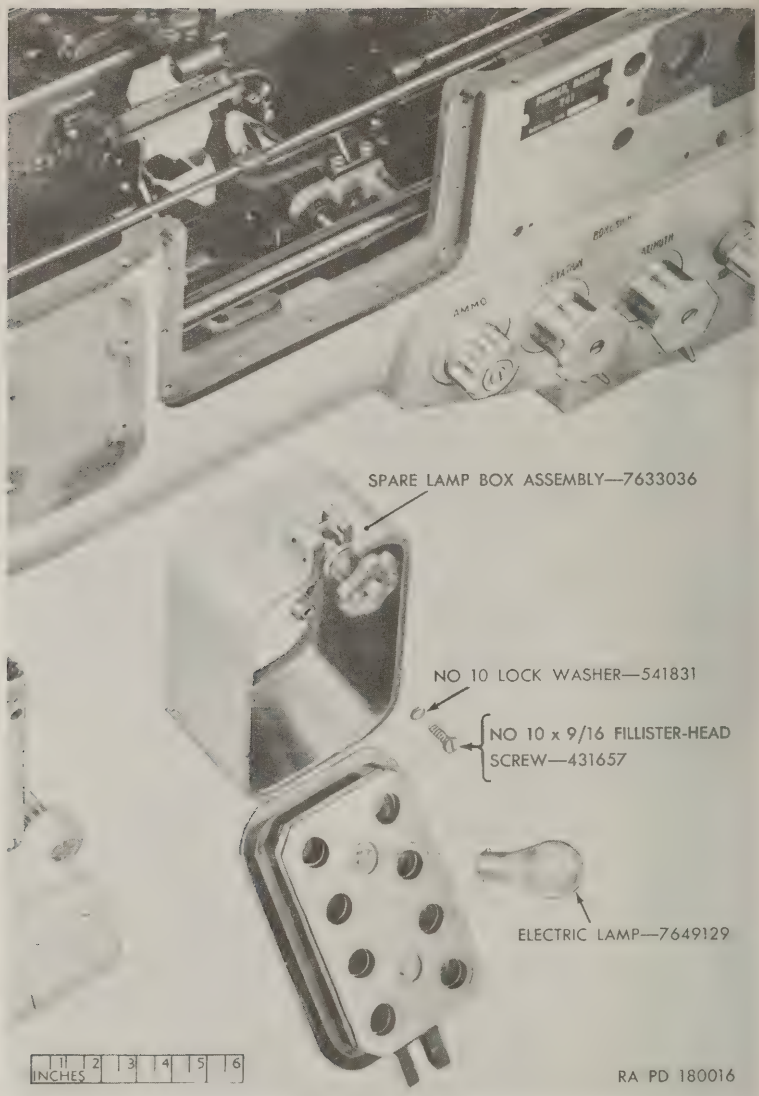



*Figure 77. Removal of spare lamp box assembly.*

## 90. Removal of Serrated Range Knob and Terminal Board Cover

*a.* Unscrew the safety nut (fig. 78) from the range drive assembly shaft, and slide off the serrated range knob. Tap the key from the range drive shaft so that the sealing plate will slide off easily.

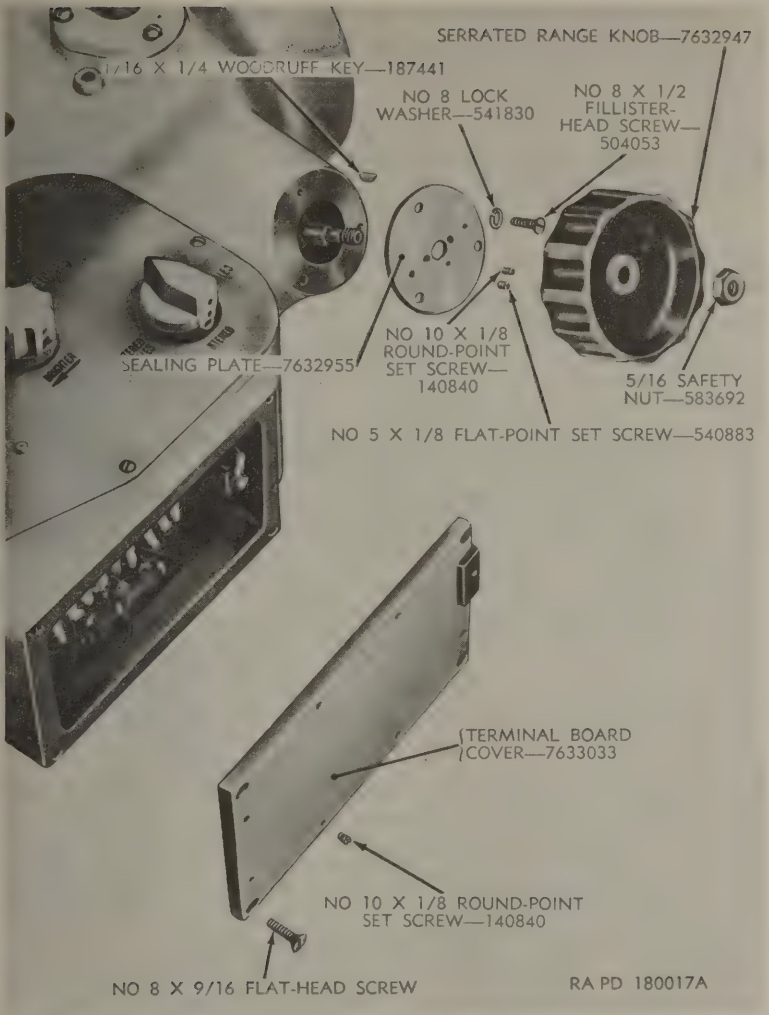

SERRATED RANGE KNOB—7632947
1/16 X 1/4 WOODRUFF KEY—187441
NO 8 LOCK WASHER—541830
NO 8 X 1/2 FILLISTER-HEAD SCREW—504053
SEALING PLATE—7632955
NO 10 X 1/8 ROUND-POINT SET SCREW—140840
5/16 SAFETY NUT—583692
NO 5 X 1/8 FLAT-POINT SET SCREW—540883
TERMINAL BOARD COVER—7633033
NO 10 X 1/8 ROUND-POINT SET SCREW—140840
NO 8 X 9/16 FLAT-HEAD SCREW
RA PD 180017A

*Figure 78. Removal of serrated range knob and terminal board cover.*

*b.* Unscrew the three fillister-head screws and lock washers that secure the sealing plate to the main housing. It may be necessary to pry the plate from the housing due to the sealing compound between the plate and the housing.

*c.* Remove the two flat-point set screws from the injection sealing ports of the plate (par. 56).

*d.* Unscrew the four fillister-head screws and pry the terminal cover from the main housing to break the seal between the cover and the housing.

*e.* Unscrew eight round-point set screws from the sealing ports of the cover and clean sealing compound (par. 63) from the cover, main housing, and the sealing plate. Use a brass wire to clean the sealing compound from the ports.

## 91. Removal of Right and Left Reticle Lamp Housing Assemblies

*a.* Unscrew the six fillister-head screws (fig. 79) and lock washers that secure the right reticle lamp housing assembly to the main housing. It may be necessary to pry the lamp housing from the main housing to break the seal.

*b.* Unscrew the two hex nuts and lock washers to disconnect the two lead wires from the lamp housing.

*c.* Pull out the two straight pins.

*d.* Remove the eight round-point set screws from the injection sealing ports (par. 56) of the lamp housing assembly.

*e.* Clean the sealing compound from the lamp housing and the main housing (par. 63). Use a brass wire to clean the compound from the sealing ports.

*f.* Unscrew the four fillister-head screws and lock washers that secure the left reticle lamp housing assembly to the main housing. It may be necessary to pry the lamp housing from the main housing to break the seal.

*g.* Follow procedure used in *b* through *f* above for removal of left reticle lamp housing.

## 92. Removal of Scale Transfer Prism Lever Assembly and Reticle Adjustment Housing Assembly

*a.* Unscrew the six fillister-head screws (fig. 80) and lock washers that secure the lever assembly to the main housing and pull the lever assembly from the main housing. It may be necessary to pry the lever assembly from the main housing to break the seal.

*b.* Pull one straight pin from the main housing and remove two round-point setscrews from the injection sealing ports (par. 56) in the lever assembly.

*c.* Unscrew the four fillister-head screws and lock washers that secure the reticle adjustment housing assembly to the main housing, and pull or pry the reticle adjustment housing from the main housing.

*d.* Pull the two straight pins from the main housing.

*e.* Remove the two round-point set screws from the injection sealing ports of the reticle adjustment housing assembly, and clean the sealing compound from the reticle adjustment assembly, the lever assembly and the main housing (par. 65). Insert a brass wire in the sealing ports to remove the compound.

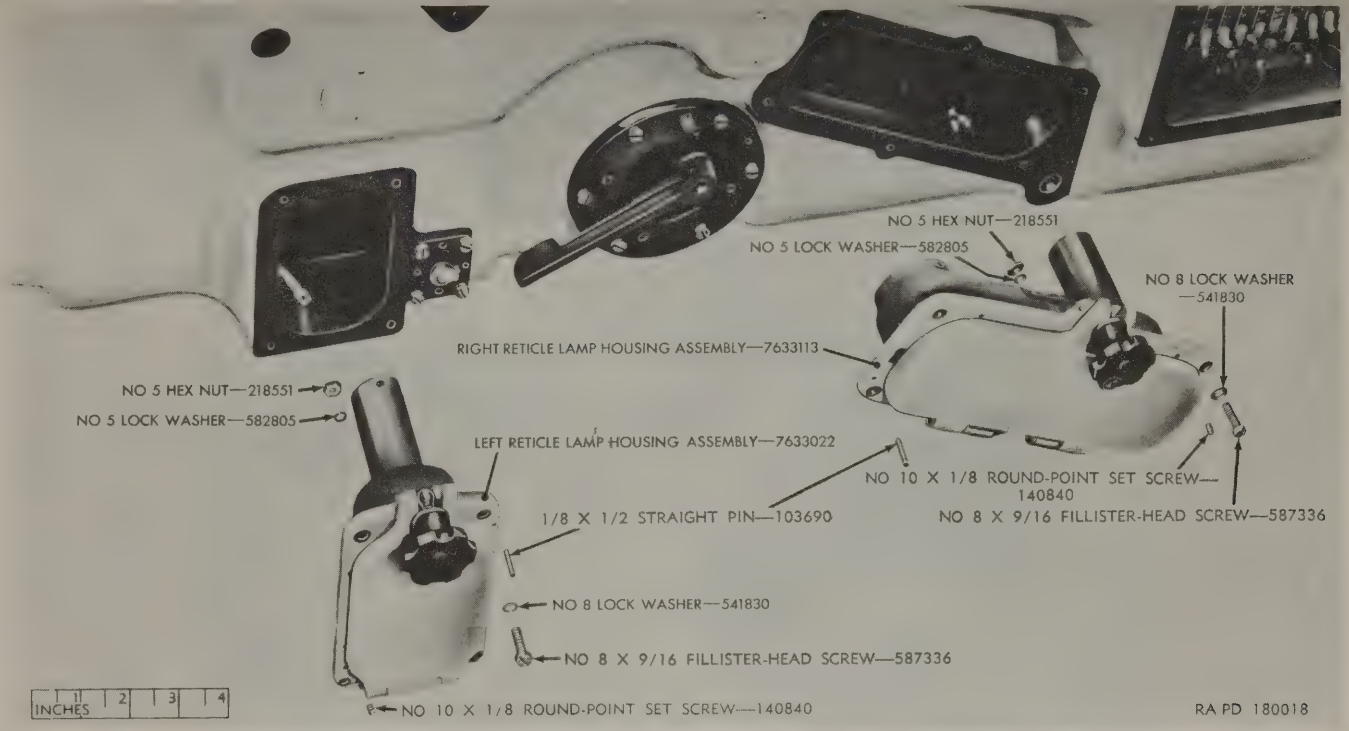

NO 5 HEX NUT—218551
NO 5 LOCK WASHER—582805
NO 8 LOCK WASHER —541830
RIGHT RETICLE LAMP HOUSING ASSEMBLY—7633113
NO 5 HEX NUT—218551
NO 5 LOCK WASHER—582805
LEFT RETICLE LAMP HOUSING ASSEMBLY—7633022
NO 10 X 1/8 ROUND-POINT SET SCREW— 140840
1/8 X 1/2 STRAIGHT PIN—103690
NO 8 X 9/16 FILLISTER-HEAD SCREW—587336
NO 8 LOCK WASHER—541830
NO 8 X 9/16 FILLISTER-HEAD SCREW—587336
INCHES 1 2 3 4
NO 10 X 1/8 ROUND-POINT SET SCREW—140840
RA PD 180018

*Figure 79. Removal of right and left reticle lamp housing assemblies.*

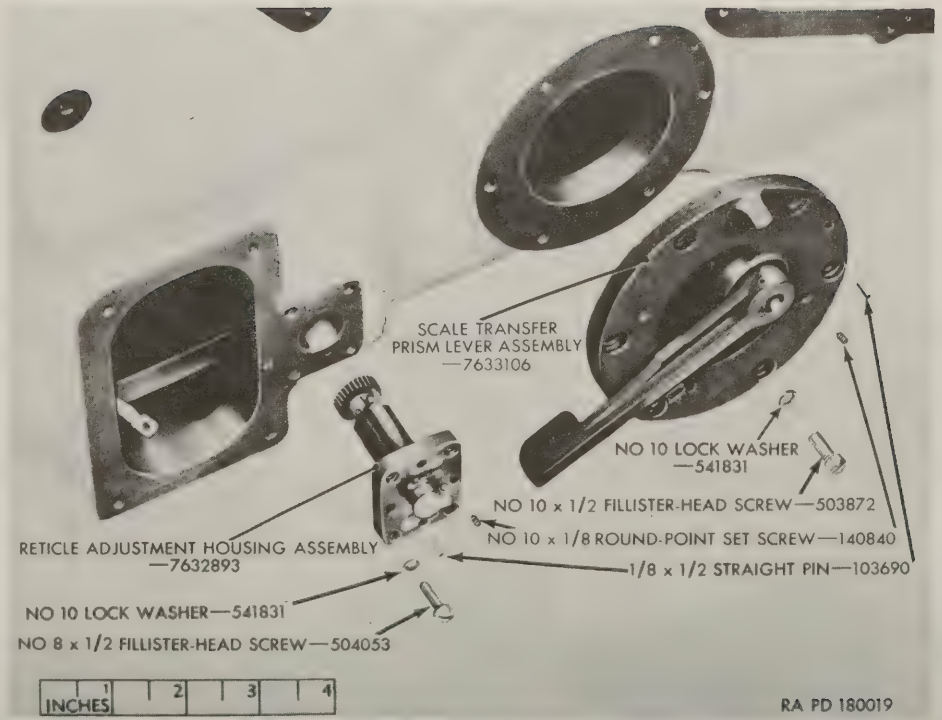



*Figure 80. Removal of scale transfer prism lever assembly and reticle adjustment housing assembly.*

## 93. Removal of Lower Front Control Panel Assembly, Adapter Plate Assembly and Bore Sight Locking Levers

*a.* Drive out the two taper pins (fig. 81) and remove the two flat-point set screws from the locking levers (par. 56). Pull the two locking levers from the cams.

*b.* Unscrew the seven oval-head screws that secure the control panel assembly to the adapter plate assembly and pull the panel assembly from the adapter plate assembly. Unscrew the nine fillister-head screws from the adapter plate assembly and remove the two screws that secure the wire terminals to the resistor board assembly.

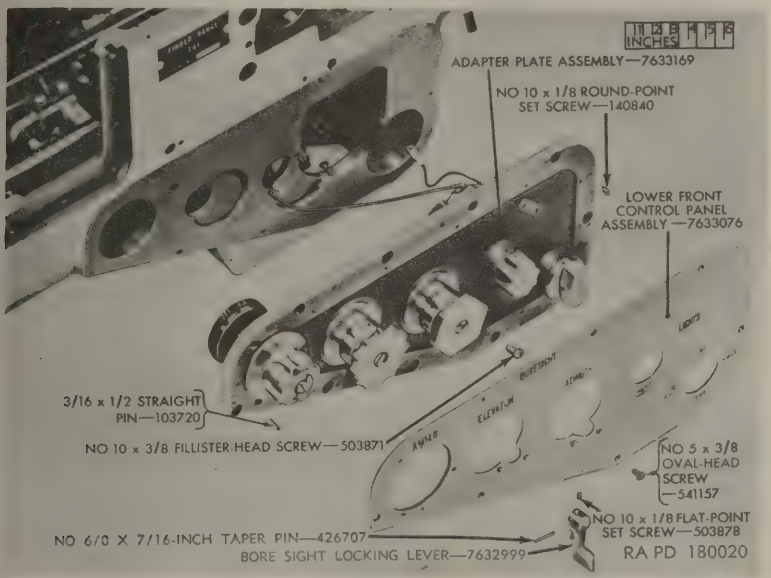

INCHES
ADAPTER PLATE ASSEMBLY—7633169
NO 10 x 1/8 ROUND-POINT SET SCREW—140840
LOWER FRONT CONTROL PANEL ASSEMBLY—7633076
3/16 x 1/2 STRAIGHT PIN—103720
NO 10 x 3/8 FILLISTER-HEAD SCREW—503871
NO 5 x 3/8 OVAL-HEAD SCREW—541157
NO 10 x 1/8 FLAT-POINT SET SCREW—503878
NO 6/0 X 7/16-INCH TAPER PIN—426707
BORE SIGHT LOCKING LEVER—7632999
RA PD 180020

*Figure 81. Removal of lower front control panel assembly, adapter plate assembly, and bore sight locking levers.*

*c.* Pull out, or if necessary, pry off the adapter plate assembly from the main housing to break the seal. Pull out the two straight pins and remove the eleven round-point set screws from the injection sealing ports in the adapter plate assembly (par. 56).

*d.* Clean the sealing compound from the adapter plate and the main housing (par. 65). Insert a brass wire into the sealing ports to remove the compound.

## 94. Removal of Eyepiece Elevation Link, Filter Lever Assembly, and Plug

*a.* Remove the cup-point set screw (fig. 82) from the elevation link (par. 56), drive out the straight pin, and pull the link from the main housing.

*b.* Unscrew the three fillister-head screws and lock washers that secure the filter lever assembly to the main housing. Pull or if necessary, pry the lever assembly from the main housing to break the seal.

*c.* Pull out two straight pins and remove the two round-point set screws from the injection sealing ports of the filter lever assembly.

*d.* Clean the sealing compound from the lever assembly and the main housing (par. 63). Unscrew the pipe plug from the main housing and clean the compound from the threads of the housing and the plug.

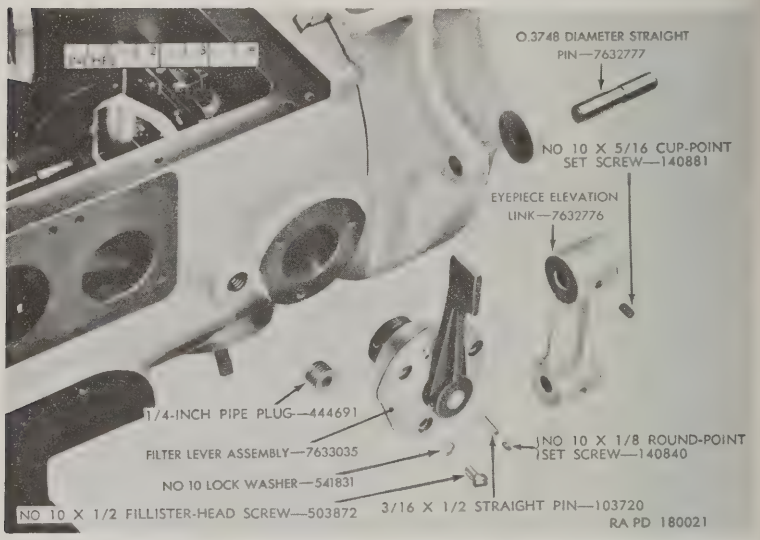

0.3748 DIAMETER STRAIGHT PIN—7632777
NO 10 X 5/16 CUP-POINT SET SCREW—140881
EYEPIECE ELEVATION LINK—7632776
1/4-INCH PIPE PLUG—444691
FILTER LEVER ASSEMBLY—7633035
NO 10 LOCK WASHER—541831
NO 10 X 1/2 FILLISTER-HEAD SCREW—503872
NO 10 X 1/8 ROUND-POINT SET SCREW—140840
3/16 X 1/2 STRAIGHT PIN—103720
RA PD 180021

*Figure 82. Removal of eyepiece elevation link, filter lever assembly, and plug.*

## 95. Removal of Right Bearing Assembly and Sealing Window Cell Assembly

*a.* Engage snap ring pliers in the snap ring (fig. 83), compress the ring and remove from the main housing.

*b.* Slide the window cell assembly from the main housing.

*c.* Press down the pawl locking plunger to free the bearing assembly and slide the bearing assembly from the housing.

## 96. Removal of Left Bearing Assembly and Sealing Window Cell Assembly

*a.* Engage snap ring pliers in the snap ring (fig. 84), compress the ring and remove from the main housing.

*b.* Slide the window cell assembly from the main housing.

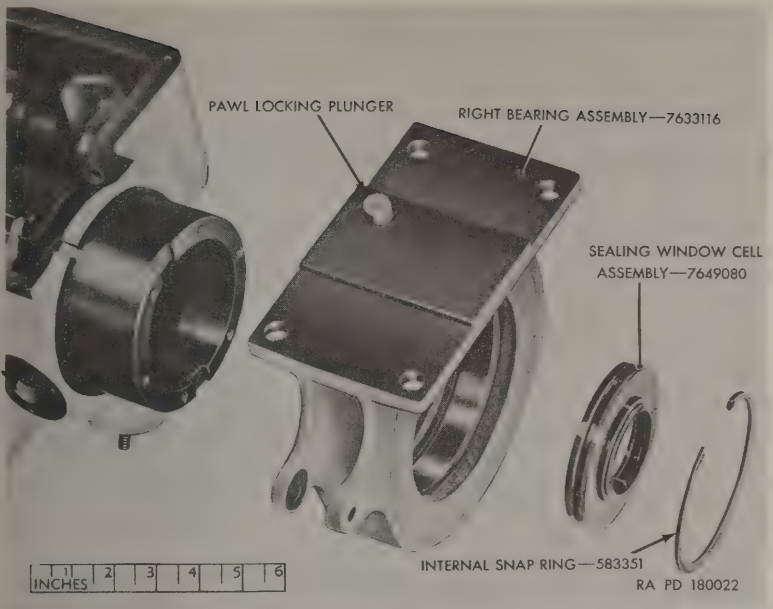



*Figure 83. Removal of right bearing assembly and sealing window cell assembly.*

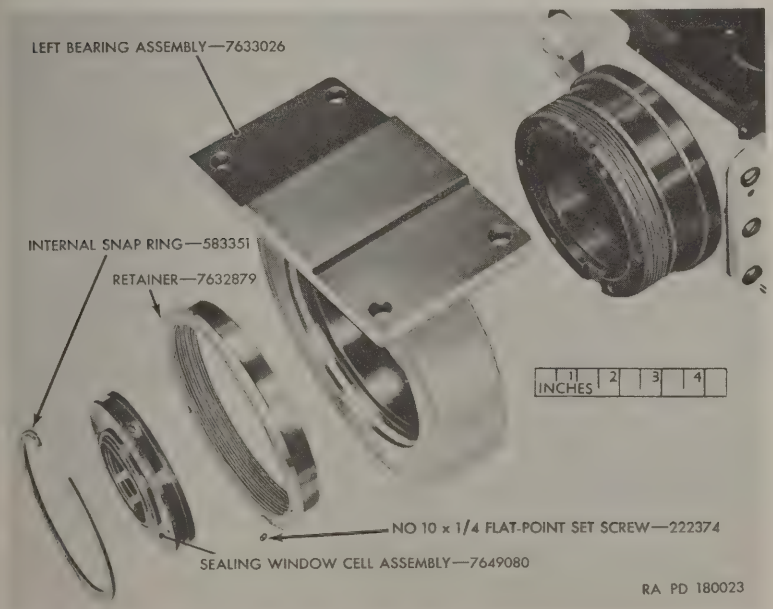



*Figure 84. Removal of left bearing assembly and sealing window cell assembly.*

*c.* Remove the flat-point set screw from the retainer (par. 56), unscrew the retainer from the main housing (par. 60) using an improvised $6\frac{7}{16}$-inch spanner hook wrench, (fig. 49) and slide the bearing from the main housing.

### 97. Removal of Ballistic Cam Housing Assembly and Cover (T41)

*a.* Unscrew the four socket-head cap screws (fig. 85) and lock washers to free the cam housing cover from the bellows plate.

*b.* Unscrew the five fillister-head screws and lock washers and remove the cover from the ballistic cam housing assembly.

*c.* Pull the two straight pins from the cam housing assembly, and remove the four round-point set screws from the injection sealing ports of the cover (par. 56).

*d.* Unscrew four socket-head screws and lock washers that secure the bellows plate to the main housing.

*e.* Unscrew the seven fillister-head screws and lock washers that secure the cam housing assembly to the main housing and remove the cam housing assembly.

*f.* Pull the two straight pins from the main housing and remove the five round-point set screws from the injection sealing ports of the cam housing assembly.

*g.* Clean the sealing compound from the cam housing, cover, and main housing (par. 65). Insert a brass wire into the sealing ports to remove the compound.

### 98. Removal of Ballistic Cam Housing Assembly and Cover (M12)

*a.* Disconnect the receptacle of the harness assembly (fig. 86) from the receptacle of the wire harness by removing two hex nuts with lock washers to free the two clamps.

*b.* Follow the procedure in paragraph 97 to remove the cam housing assembly from the main housing.

*c.* Remove the clip that secures the harness assembly to the main housing by removing the screw and lock washer.

### 99. Removal of Right Penta Reflector Assembly and Flexible Shafts

*a.* Unscrew the three fillister-head screws (fig. 87) and lock washers that secure the reflector assembly to the main housing and lift the reflector assembly from the main housing.

*Note.*—Keep reflectors of this assembly in a set separate from those of left penta reflector assembly since original sets are matched.

*b.* Slide the two flexible shafts from the collimator assembly.

*Note.*—The taper pins were driven out in removal of the telescope assembly (par. 87).

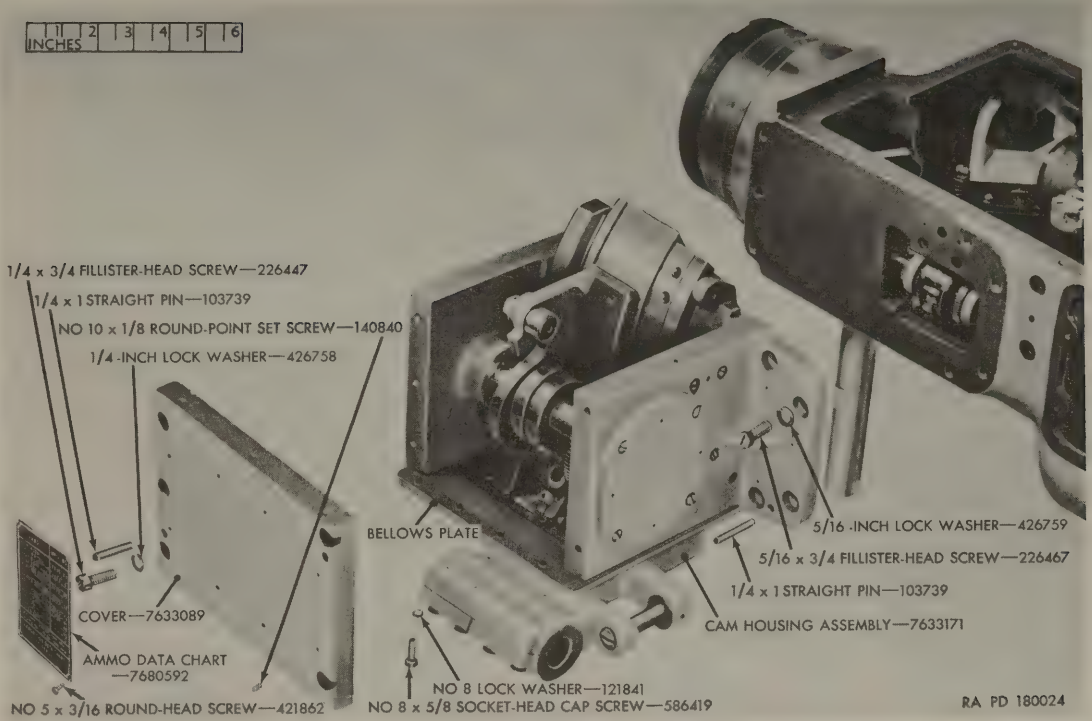

INCHES
1/4 x 3/4 FILLISTER-HEAD SCREW—226447
1/4 x 1 STRAIGHT PIN—103739
NO 10 x 1/8 ROUND-POINT SET SCREW—140840
1/4-INCH LOCK WASHER—426758
COVER—7633089
AMMO DATA CHART —7680592
NO 5 x 3/16 ROUND-HEAD SCREW—421862
BELLOWS PLATE
NO 8 LOCK WASHER—121841
NO 8 x 5/8 SOCKET-HEAD CAP SCREW—586419
5/16-INCH LOCK WASHER—426759
5/16 x 3/4 FILLISTER-HEAD SCREW—226467
1/4 x 1 STRAIGHT PIN—103739
CAM HOUSING ASSEMBLY—7633171
RA PD 180024

*Figure 85. Removal of ballistic cam housing assembly and cover (T41).*

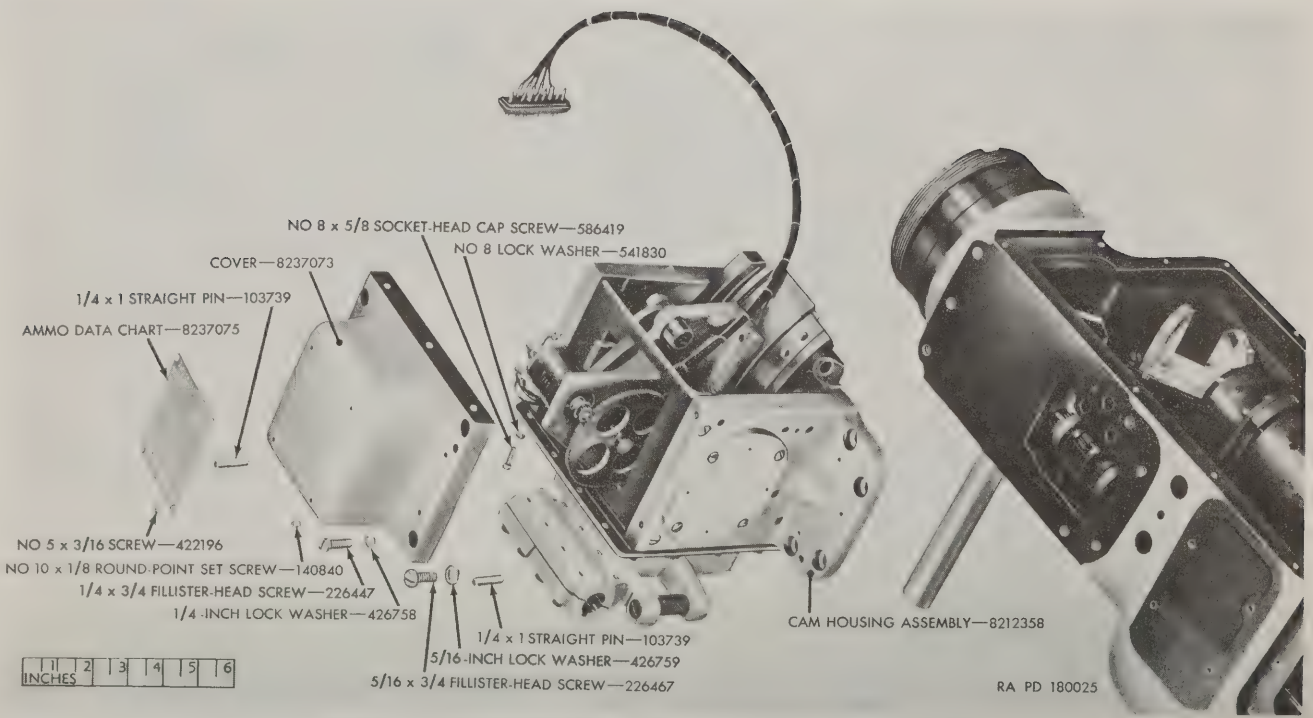

NO 8 x 5/8 SOCKET-HEAD CAP SCREW—586419
NO 8 LOCK WASHER—541830
COVER—8237073
1/4 x 1 STRAIGHT PIN—103739
AMMO DATA CHART—8237075
NO 5 x 3/16 SCREW—422196
NO 10 x 1/8 ROUND-POINT SET SCREW—140840
1/4 x 3/4 FILLISTER-HEAD SCREW—226447
1/4 -INCH LOCK WASHER—426758
5/16 x 3/4 FILLISTER-HEAD SCREW—226467
5/16-INCH LOCK WASHER—426759
1/4 x 1 STRAIGHT PIN—103739
CAM HOUSING ASSEMBLY—8212358
INCHES
RA PD 180025

*Figure 86. Removal of ballistic cam housing assembly and cover (M12).*

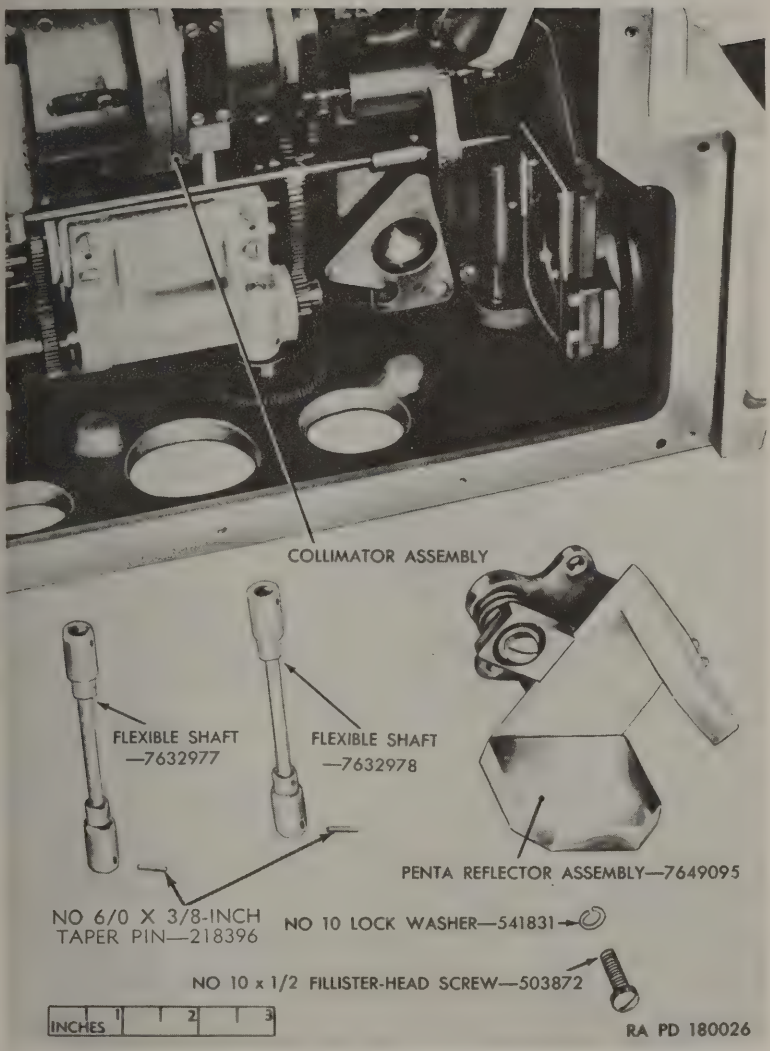



*Figure 87. Removal of right penta reflector assembly and flexible shafts.*

### 100. Removal of Left Penta Reflector Assembly

Unscrew the three fillister-head screws (fig. 88) and lock washers that secure the reflector assembly to the main housing and remove the reflector assembly. See note in paragraph 99*a*.

### 101. Removal of Filter Shaft Assembly

*a.* Drive two taper pins (fig. 89) from the two couplings (par. 59*a*) at the ends of the filter shaft assembly to disengage the shaft assembly from the filter and compensator assemblies.

*b.* Unscrew the two fillister-head screws and lock washers to disengage the shaft assembly from the ballistic differential housing and lift out the shaft assembly.

*c.* Pull the straight pin from the ballistic differential housing.

### 102. Removal of Collimator Assembly

*a.* Drive the taper pin from the compensator assembly end of the flexible shaft (fig. 89) that connects the compensator assembly to the ammunition, bore sight, and range scale assembly. Then pull the shaft from the compensator assembly.

*b.* Drive the taper pin (fig. 89) from the azimuth bore sight drive assembly coupling that connects the drive assembly to the flexible shaft of the scale assembly. Slide the shaft from the drive assembly leaving the flexible shaft on the scale assembly.

*c.* Drive the two taper pins from the flexible shaft that connects the elevation bore sight drive assembly to the scale assembly and slide the flexible shaft toward the bore sight drive assembly. Drive the taper pin from the pinion (fig. 89) of the ballistic differential assembly and slide the pinion back on the shaft.

*d.* Unscrew the four socket-head cap screws (fig. 90) that secure the collimator assembly to the main housing.

*e.* Lift the collimator assembly from the main housing, and pull the two straight pins from the main housing.

### 103. Removal of Compensator Assembly

*a.* Unscrew the four fillister-head screws (fig. 91) and lock washers that secure the compensator assembly to the machined surface of the range drive assembly, and lift the compensator assembly from the range drive assembly.

*b.* Pull the two straight pins from the range drive assembly.

### 104. Removal of Neutral Filter Assembly

*a.* Unscrew the two fillister-head screws (fig. 92) and lock washers that secure the filter assembly and stop to the main housing.

*b.* Lift the filter assembly and stop from the main housing and pull the two straight pins from the main housing.

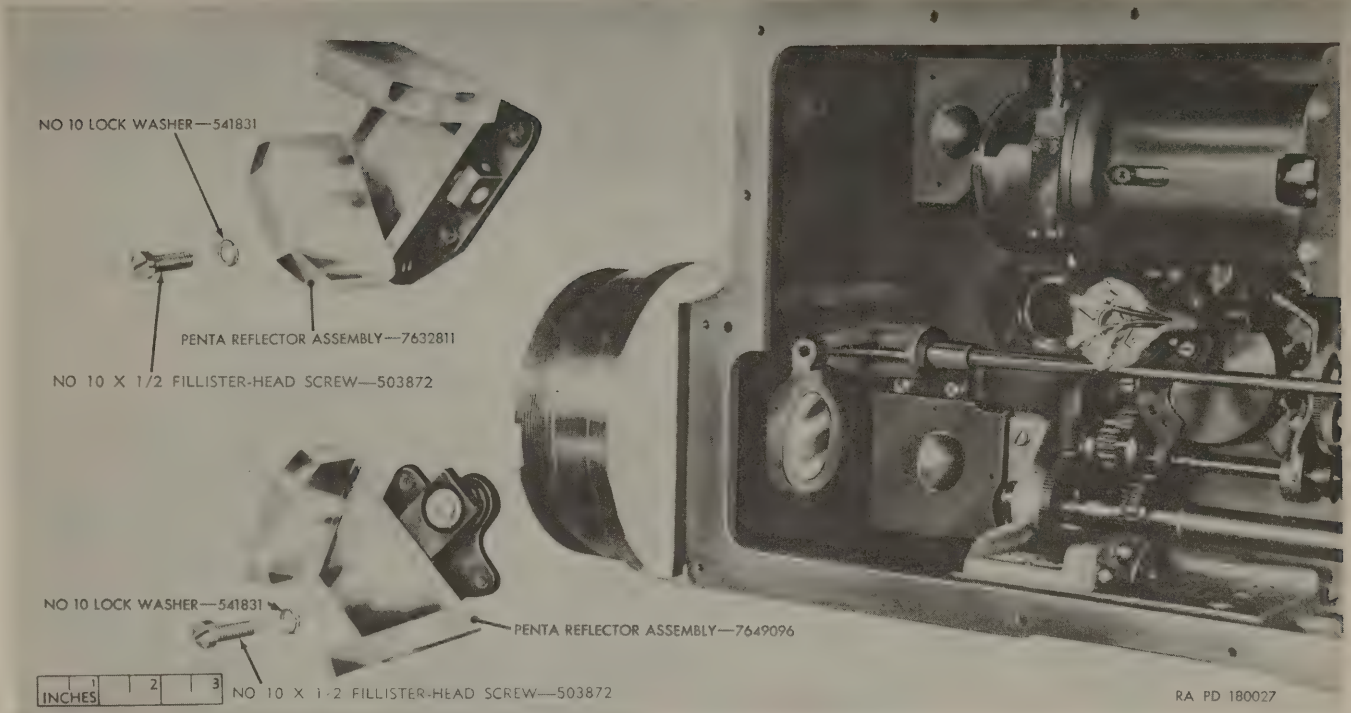



*Figure 88. Removal of left penta reflector assembly.*

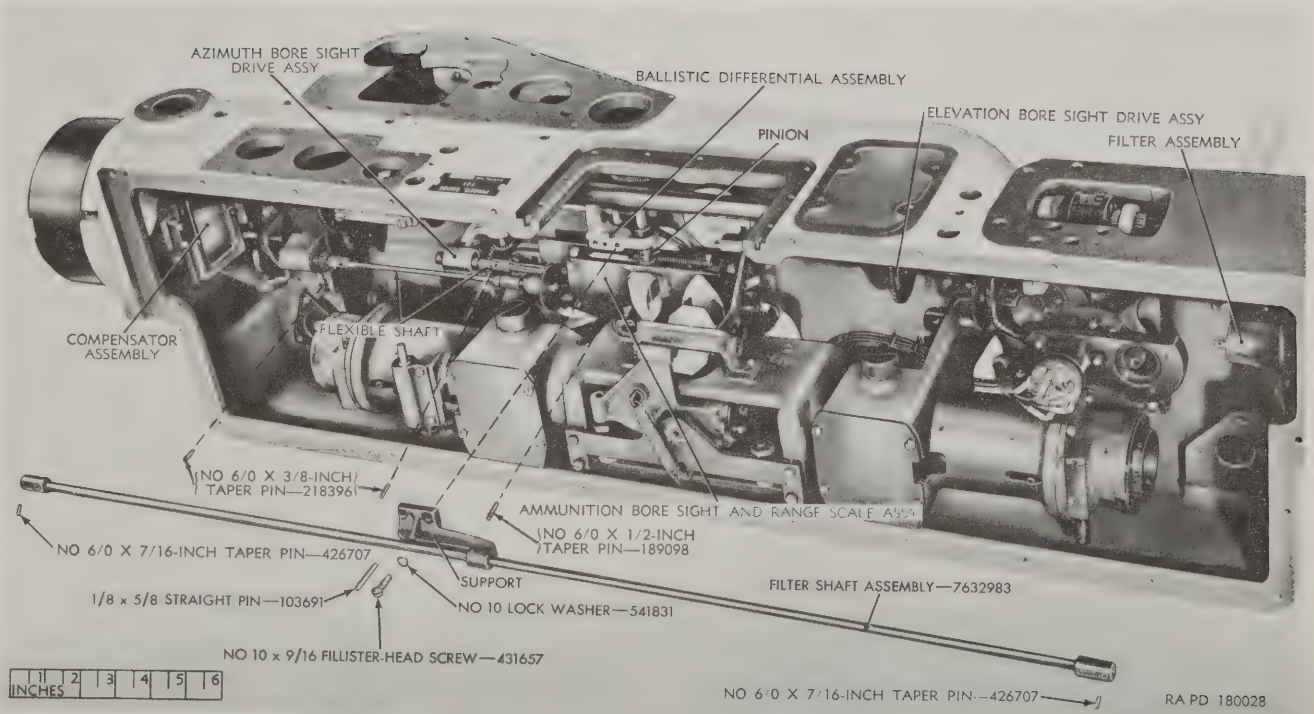



*Figure 89. Removal of filter shaft assembly.*

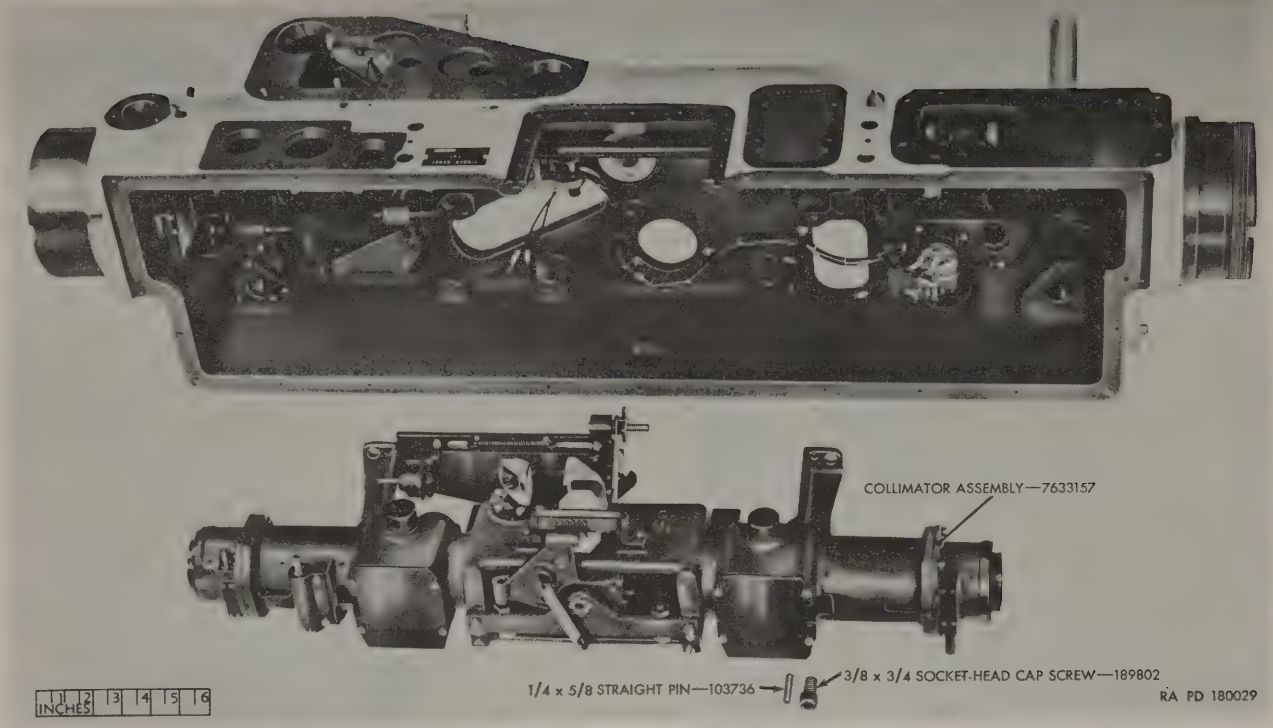



*Figure 90. Removal of collimator assembly.*

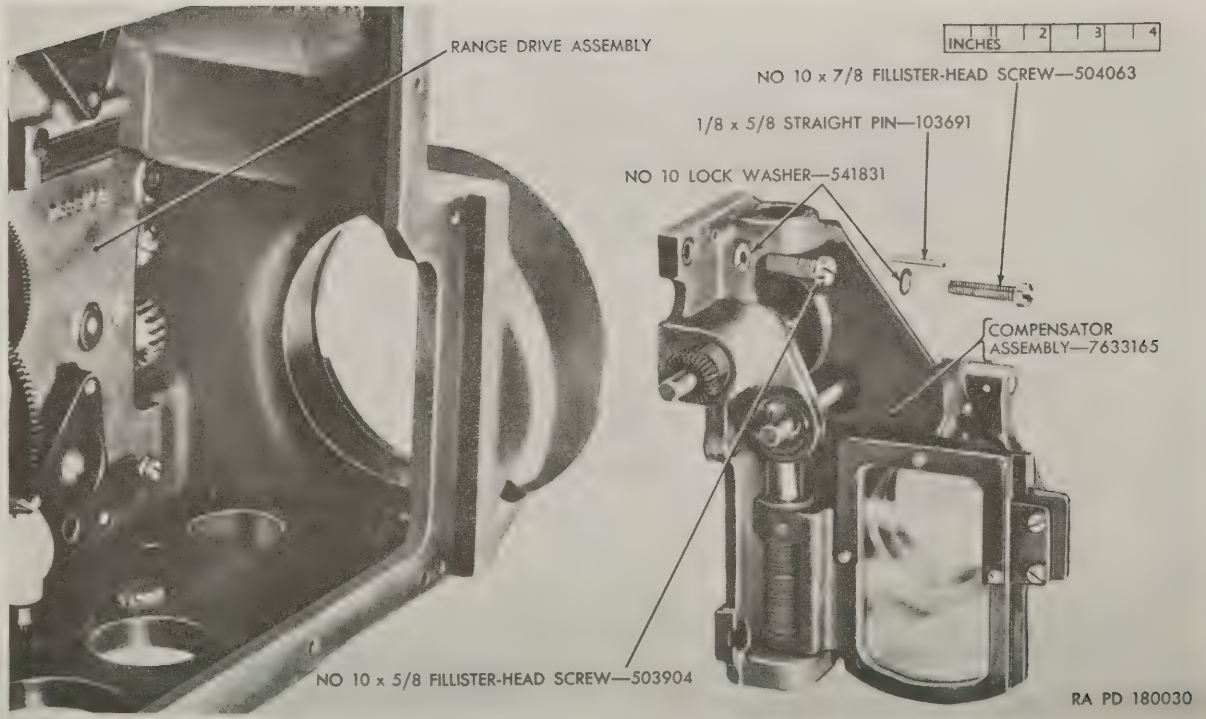



*Figure 91. Removal of compensator assembly.*

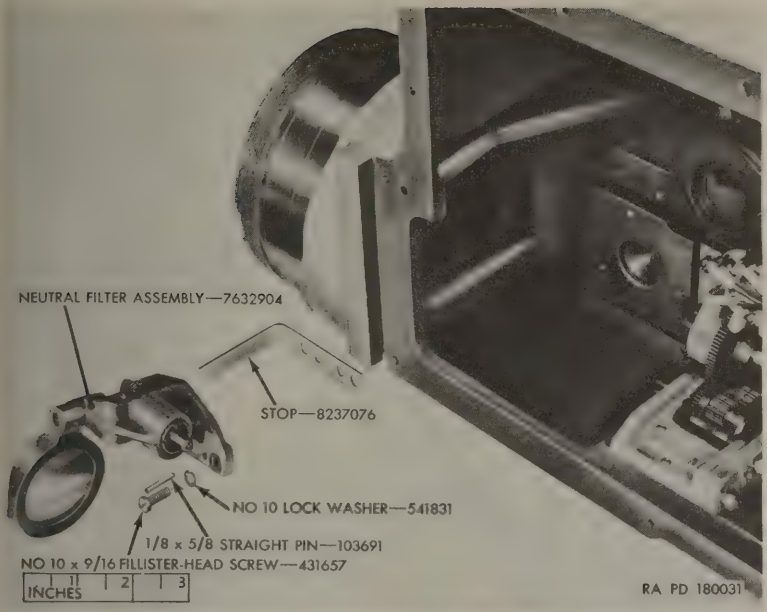



*Figure 92. Removal of neutral filter assembly.*

## 105. Removal of Superelevation Mechanism Assembly (T41)

*a.* Unscrew the two hex-nuts (fig. 93) and lock washers from the receptacle posts and pull the two receptacle clamps and the contact receptacle from the contact plug.

*b.* Unscrew the three fillister-head screws and lock washers that secure the mechanism assembly to the main housing.

*c.* Lift the mechanism assembly from the main housing and pull the two straight pins from the main housing.

## 106. Removal of Superelevation Differential Assembly

*a.* Drive the two straight pins (fig. 94) from the differential assembly and the main housing.

*b.* Unscrew the three fillister-head screws and lock washers that engage the differential assembly through the main housing.

*c.* Pull the differential assembly from the main housing, disengaging the gears of the differential assembly and the range shaft assembly.

## 107. Removal of Range Shaft Assembly

*a.* Unscrew the two fillister-head screws (fig. 95) and lock washers from the left bracket.

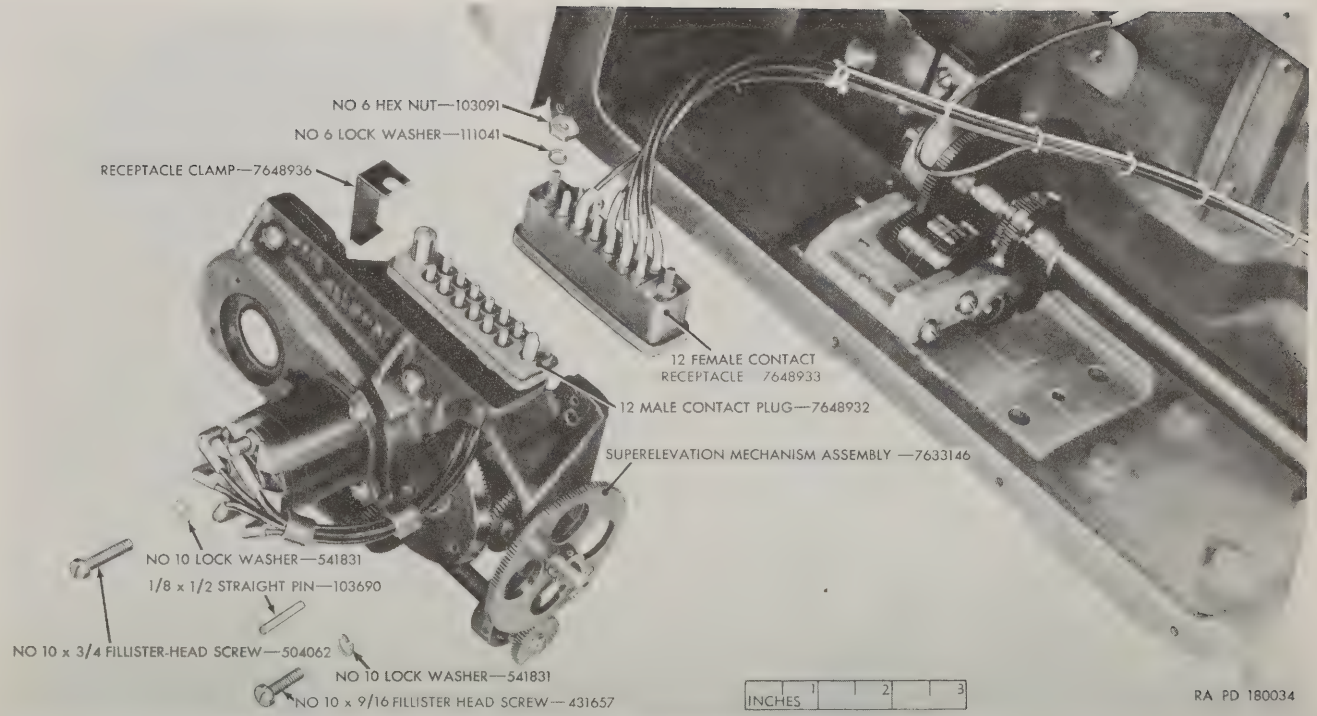

NO 6 HEX NUT—103091
NO 6 LOCK WASHER—111041
RECEPTACLE CLAMP—7648936
12 FEMALE CONTACT RECEPTACLE 7648933
12 MALE CONTACT PLUG—7648932
SUPERELEVATION MECHANISM ASSEMBLY —7633146
NO 10 LOCK WASHER—541831
1/8 x 1/2 STRAIGHT PIN—103690
NO 10 x 3/4 FILLISTER-HEAD SCREW—504062
NO 10 LOCK WASHER—541831
NO 10 x 9/16 FILLISTER HEAD SCREW—431657
INCHES 1 2 3
RA PD 180034

*Figure 93. Removal of superelevation mechanism assembly.*

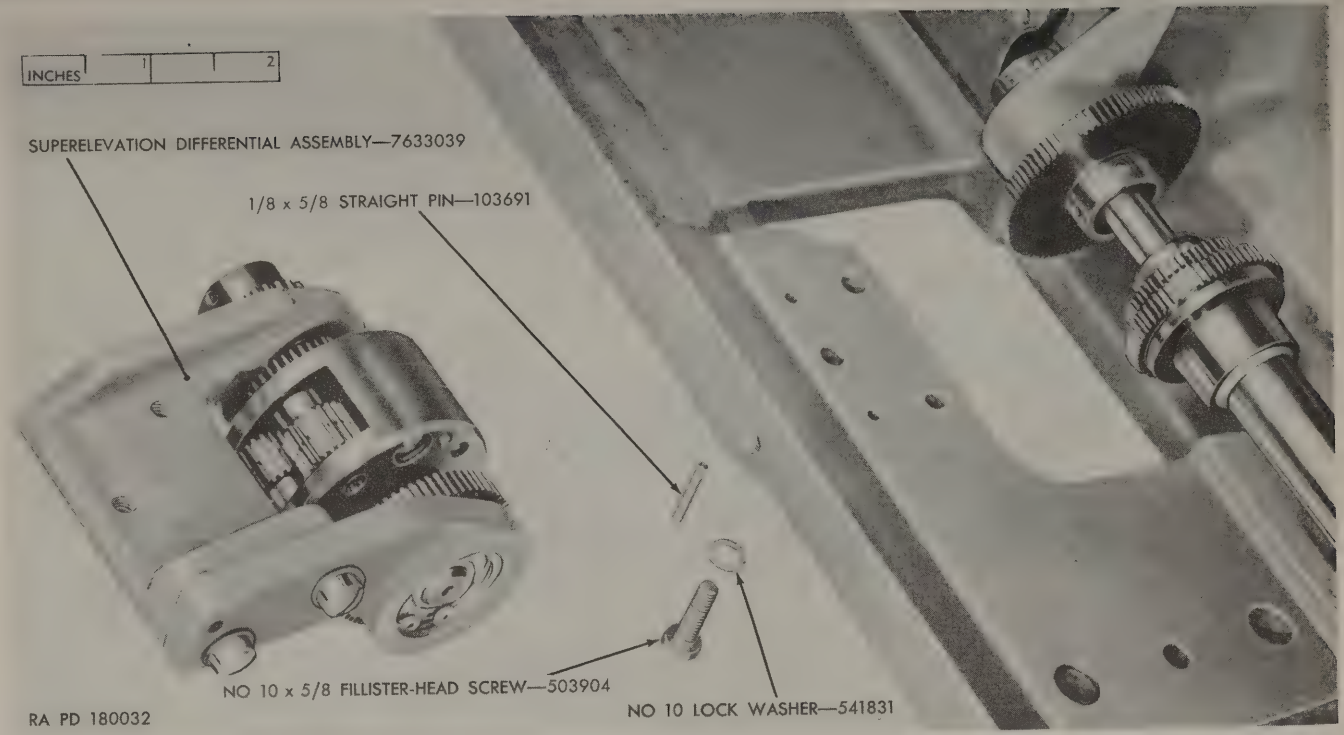



*Figure 94. Removal of superelevation differential assembly.*

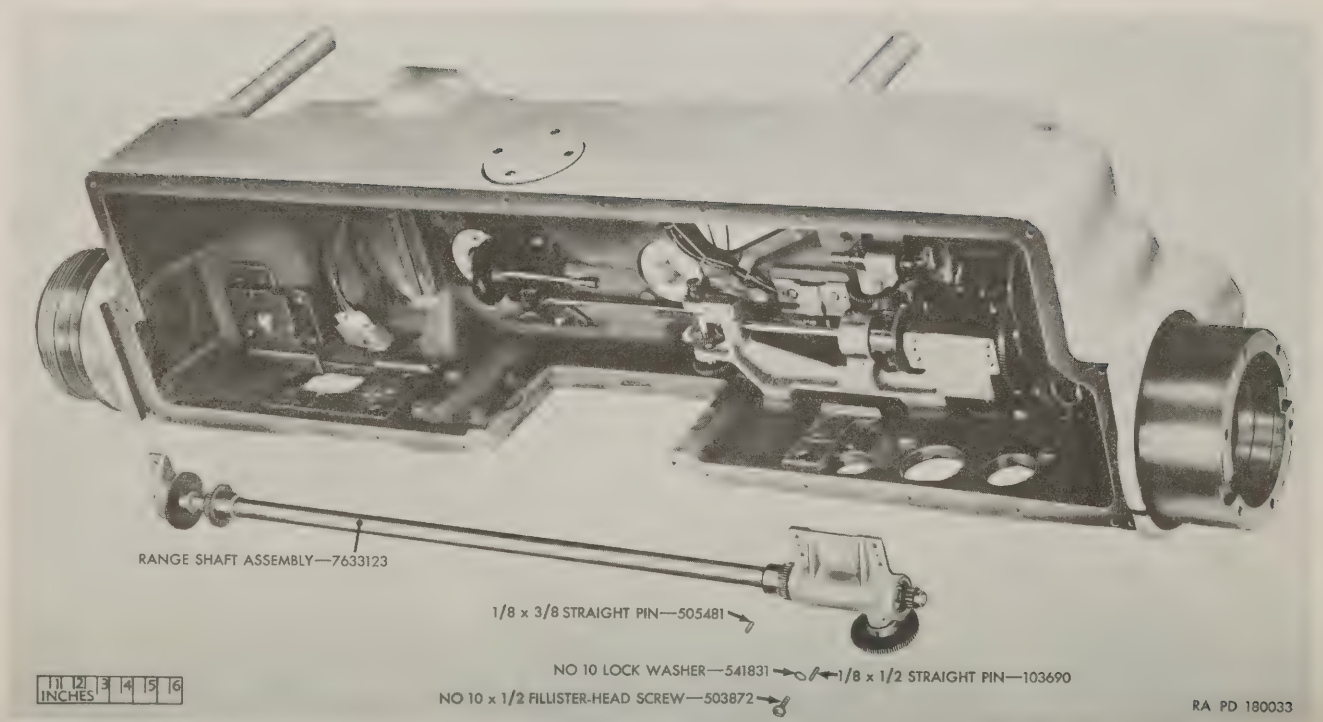

RANGE SHAFT ASSEMBLY—7633123
1/8 x 3/8 STRAIGHT PIN—505481
NO 10 LOCK WASHER—541831
1/8 x 1/2 STRAIGHT PIN—103690
NO 10 x 1/2 FILLISTER-HEAD SCREW—503872
11 12 INCHES 3 4 5 6
RA PD 180033

*Figure 95. Removal of range shaft assembly.*

*b.* Unscrew the four fillister-head screws and lock washers from the right bracket and lift the range shaft assembly from the main housing.

*c.* Pull the two straight pins from the right mounting surface of the ballistic correction differential assembly and one straight pin from the left mounting surface.

## 108. Removal of Ballistic Correction Differential Assembly

*a.* Unscrew the four fillister-head screws and lock washers (fig. 96) that engage the ballistic differential assembly through the main housing.

*b.* Push the ballistic differential assembly forward to disengage it from the two straight pins and lift the assembly from the main housing.

*c.* Drive the two straight pins from the main housing.

## 109. Removal of Elevation Bore Sight Drive Assembly

*a.* Drive the taper pin from the flexible shaft to disengage the elevation bore sight drive assembly.

*b.* Unscrew the two fillister-head screws (fig. 97) and lock washers that secure the assembly to the main housing.

*Note.*—The taper pin was removed in disconnecting the collimator assembly from the elevation bore sight drive assembly (par. 102).

*c.* Lift the elevation bore sight drive assembly from the main housing and pull the two straight pins from the main housing.

## 110. Removal of Azimuth Bore Sight Drive Assembly

*a.* Unscrew the two fillister-head screws (fig. 98) and lock washers that secure the drive assembly to the main housing.

*b.* Lift the azimuth bore sight drive assembly from the main housing and pull the two straight pins from the main housing.

## 111. Removal of Intermediate Drive Assembly and Flexible Shaft

*a.* Drive the taper pin (fig. 97) from the flexible shaft (par. 59*a*), and pull the flexible shaft from the drive assembly.

*b.* Unscrew the two fillister-head screws and lock washers that secure the drive assembly to the main housing.

*c.* Lift the intermediate drive assembly from the main housing and pull the two straight pins from the main housing.

## 112. Removal of Range Drive Assembly

*a.* Unscrew the four fillister-head screws (fig. 99) with lock washers that secure the drive assembly to the main housing.

*b.* Lift the range drive assembly from the main housing and pull the two straight pins from the main housing.

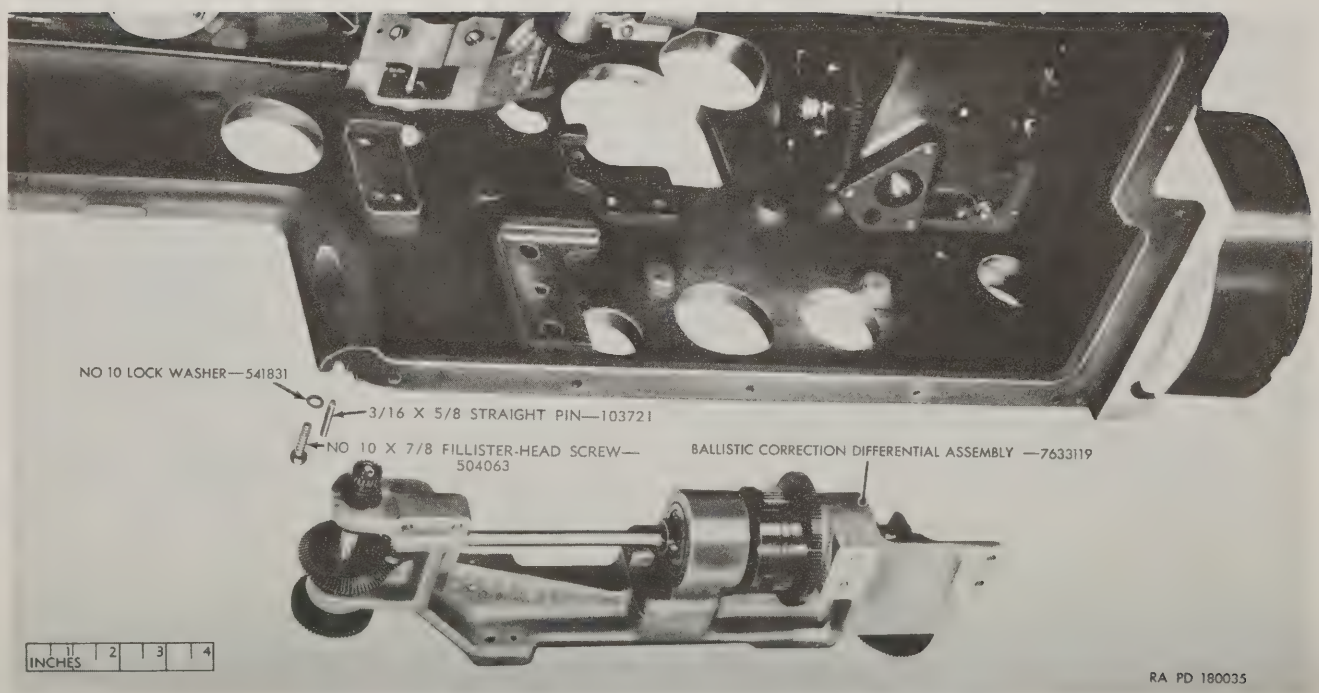



*Figure 96. Removal of ballistic correction differential assembly.*

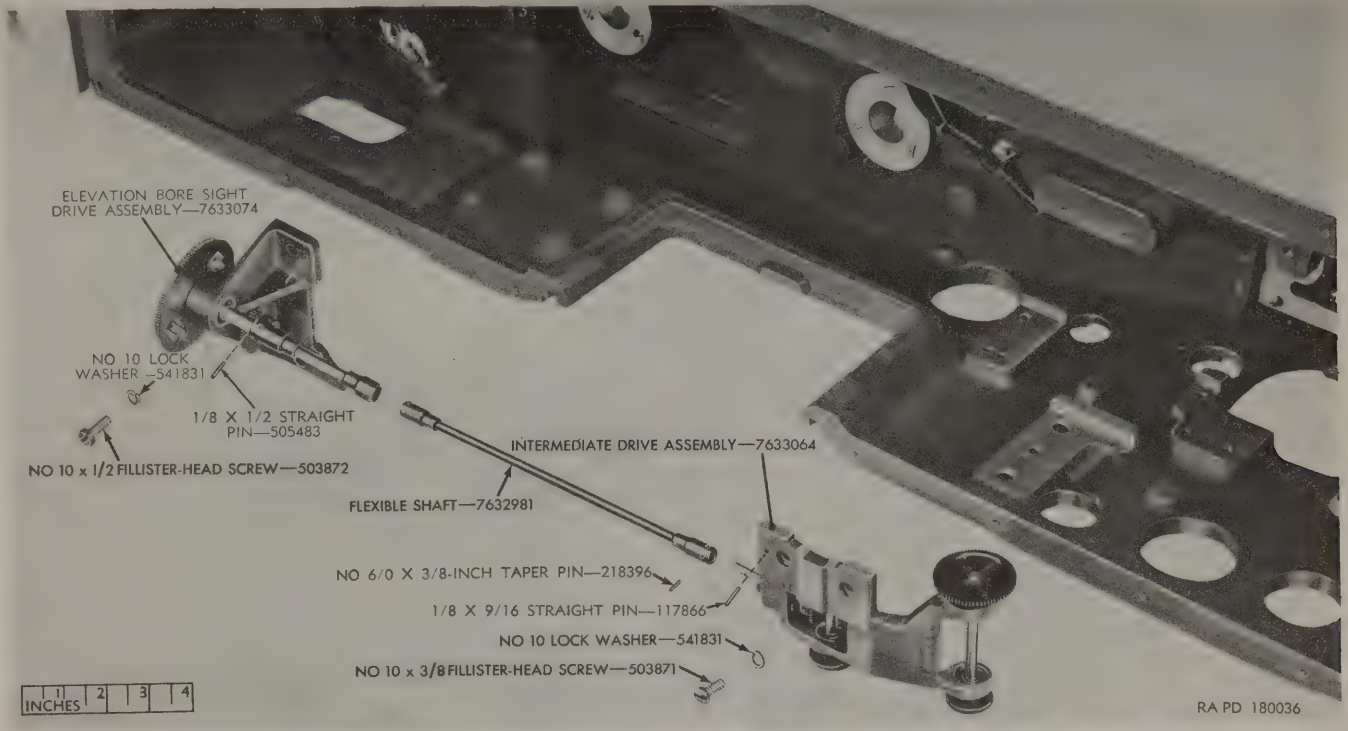

ELEVATION BORE SIGHT DRIVE ASSEMBLY—7633074
NO 10 LOCK WASHER—541831
1/8 X 1/2 STRAIGHT PIN—505483
NO 10 x 1/2 FILLISTER-HEAD SCREW—503872
INTERMEDIATE DRIVE ASSEMBLY—7633064
FLEXIBLE SHAFT—7632981
NO 6/0 X 3/8-INCH TAPER PIN—218396
1/8 X 9/16 STRAIGHT PIN—117866
NO 10 LOCK WASHER—541831
NO 10 x 3/8 FILLISTER-HEAD SCREW—503871
INCHES 1 2 3 4
RA PD 180036

*Figure 97. Removal of elevation bore sight drive assembly and intermediate drive assembly.*

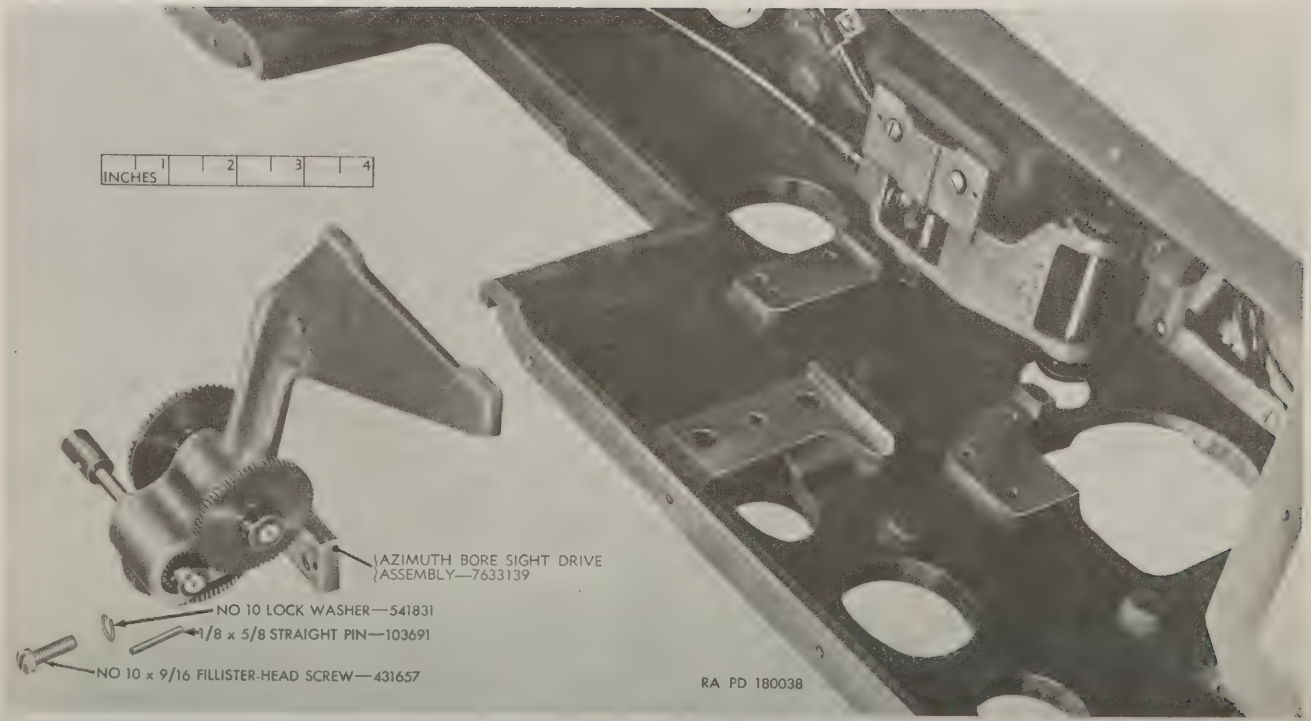



*Figure 98. Removal of azimuth bore sight drive assembly.*

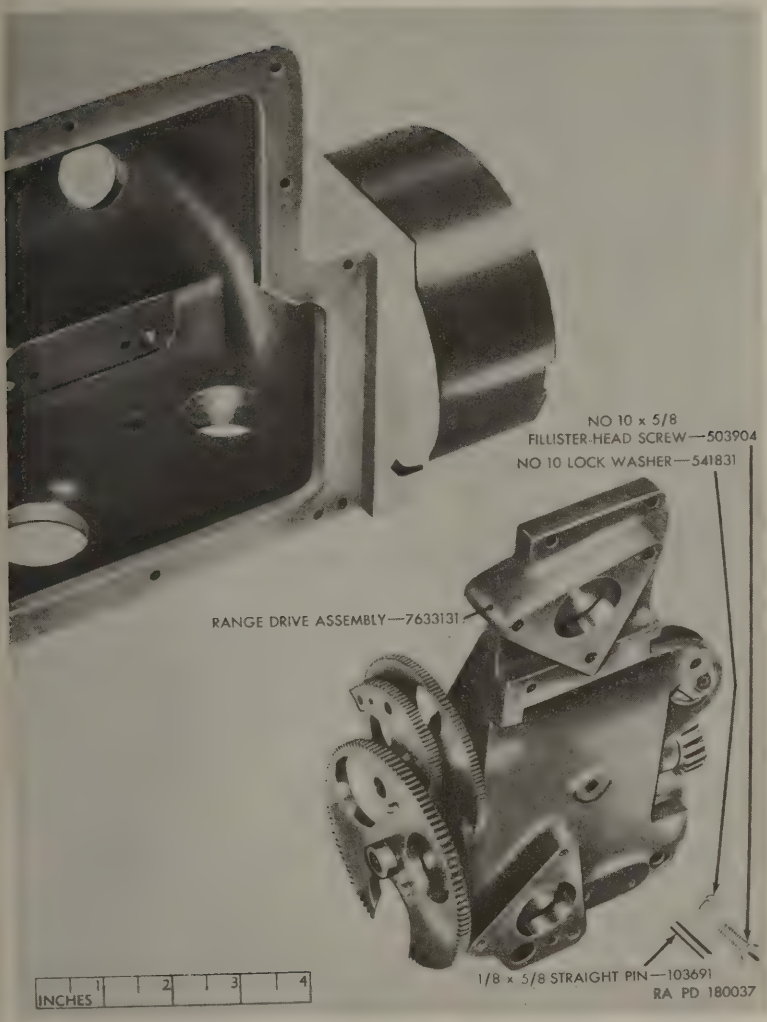



*Figure 99. Removal of range drive assembly.*

### 113. Removal of Receptacle and Receptacle Housing Plate

*a.* Disconnect the six receptacle lead wires (fig. 100) by removing seven screws from the resistor board assembly.

*b.* Unscrew the four fillister-head screws and lock washers that secure the receptacle to the main housing.

*c.* Pull the receptacle and the gasket from the main housing.

*d.* Unscrew the four fillister-head screws and lock washers that secure the receptacle plate to the main housing.

*e.* Pull the receptacle plate and the gasket from the main housing.

### 114. Removal of Wire Harness

*a.* Unscrew the eight screws (fig. 101) from the resistor board assembly to disconnect the eight wire terminals.

*b.* Unscrew the five fillister-head screws and lock washers from the five closed clips.

*c.* Lift the wire harness and the five clips from the main housing.

### 115. Removal of Resistor Board Assembly

Unscrew the three fillister-head screws (fig. 102) and lock washers that secure the resistor board assembly to the main housing. Lift the resistor board assembly from the main housing.

### 116. Removal of Sealing Plug and Nameplate

*a.* Unscrew the three flat-head screws (fig. 103) from the sealing plug and pry the plug from the main housing to break the seal.

*b.* Unscrew the two flat-point set screws from the injection sealing ports of the plug (par. 56) and clean the sealing compound from the sealing plug and the main housing (par. 63). Insert a brass wire into the sealing ports to loosen the compound.

*c.* Remove the two round-head screws that secure the nameplate to the main housing and remove the nameplate.

### 117. Removal of Cycle Valve and Cycle Valve Cap

*a.* Unscrew the valve cap (fig. 104) from the cycle valve using the improvised desiccation valve wrench (fig. 105).

*b.* Unscrew the nut and washer from the valve cap. Remove the other washer from the valve and slide the valve from the main housing.

*c.* Slide the rubber washer from the cycle valve.

*Note.*—Follow the same procedure in the removal of the other cycle valves and valve caps.

### 118. Removal of Collimator Cover and Mounting Posts

*a.* Unscrew the four flat-head screws (fig. 106) and pry the cover from the main housing to break the seal.

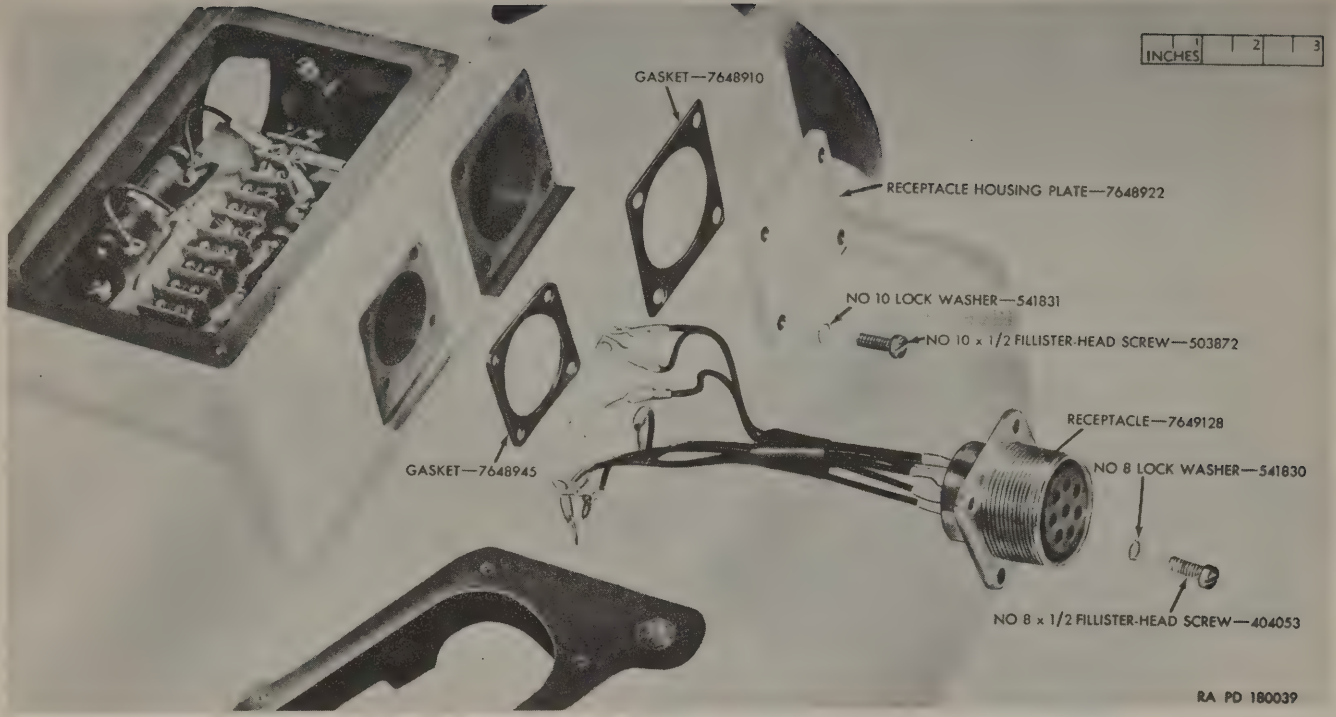



*Figure 100. Removal of receptacle and receptacle housing plate.*

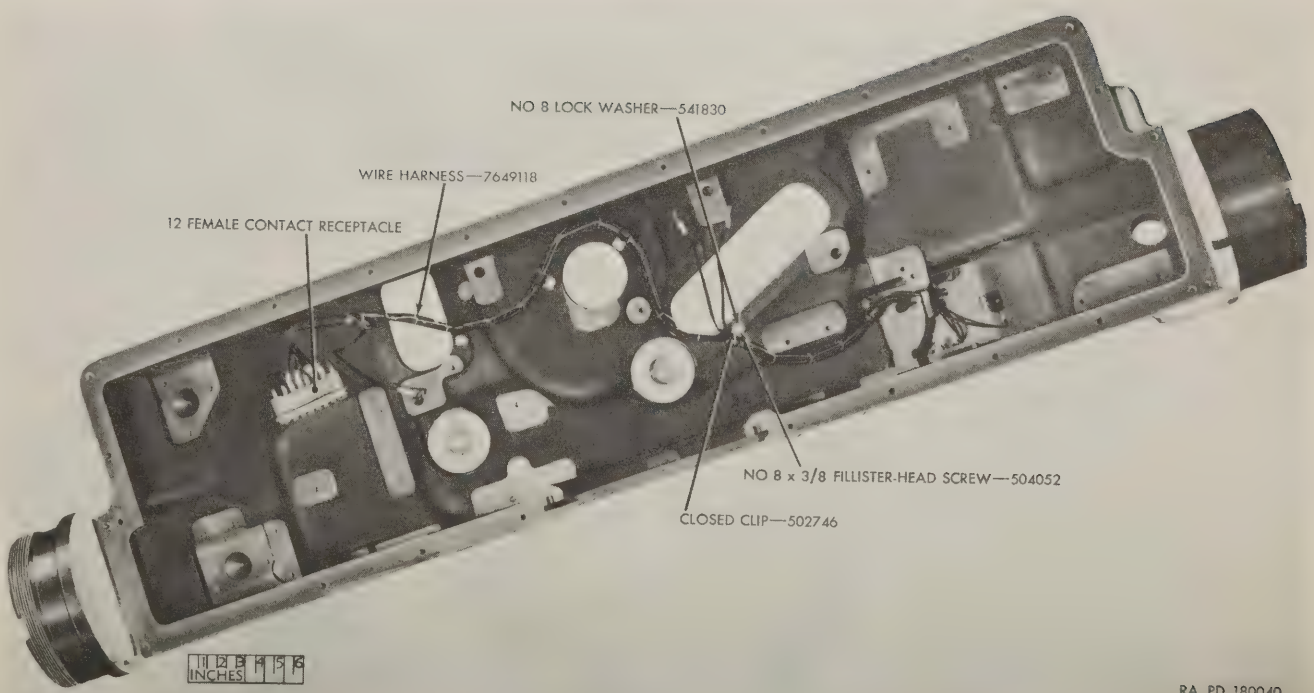



*Figure 101. Removal of wire harness.*

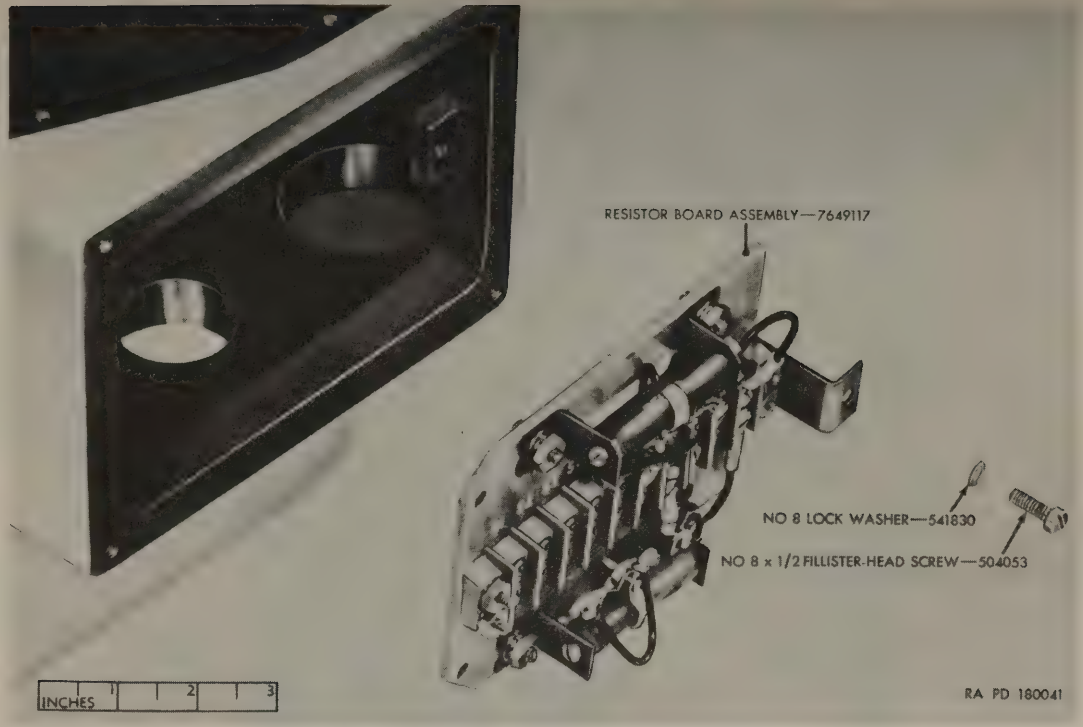



*Figure 102. Removal of resistor board assembly.*

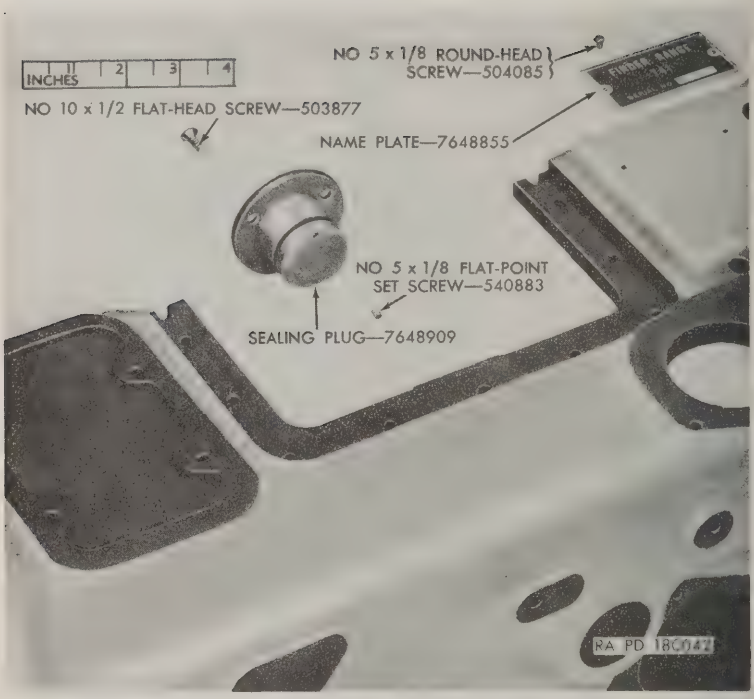



*Figure 103. Removal of sealing plug and nameplate.*

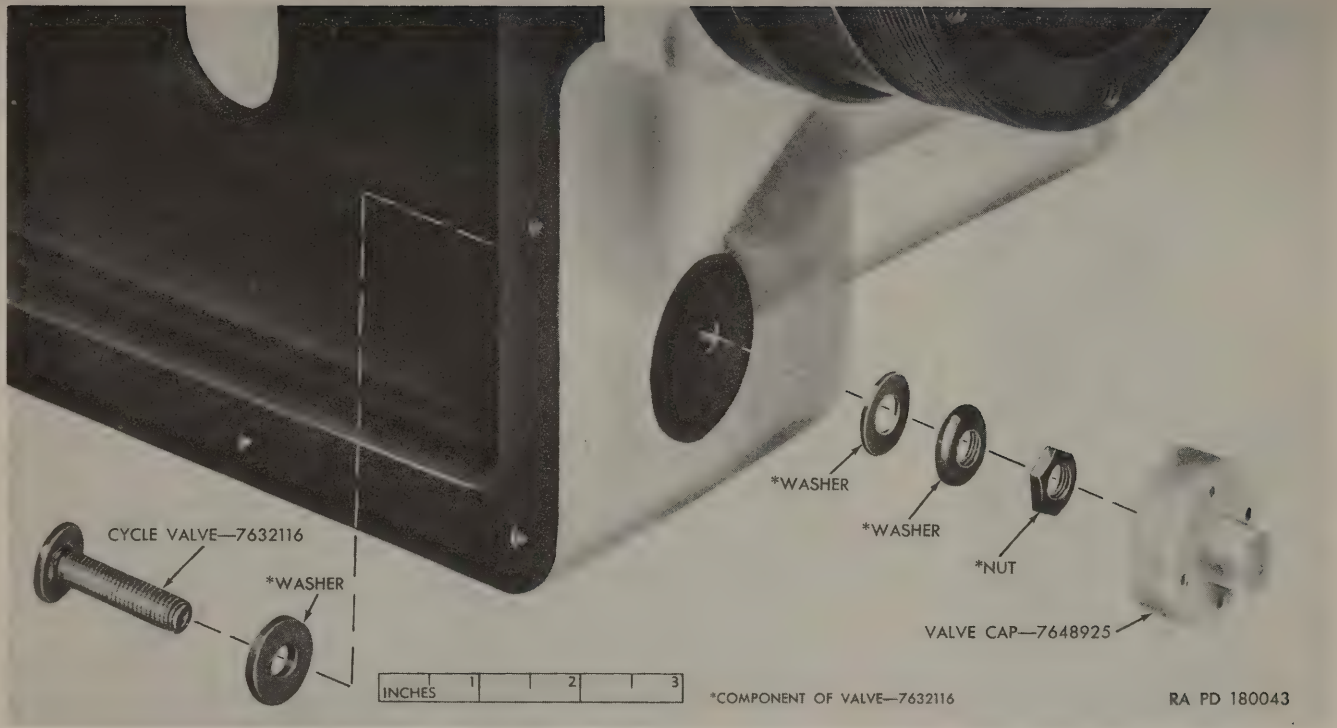



*Figure 104. Removal of cycle valve and cycle valve cap.*

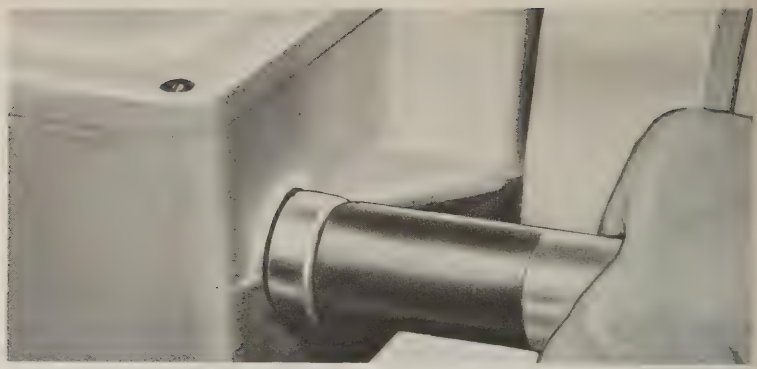


*Figure 105. Using desiccation valve wrench for cycle valve cap.*

*Figure 106. Removal of collimator cover and mounting posts.*

*b.* Remove the four round-point set screws (par. 56) from the injection sealing ports of the cover.

*c.* Clean the sealing compound from the collimator cover and the main housing (par. 63). Insert a brass wire into the sealing ports to loosen the compound.

*d.* Unscrew the three mounting posts from the main housing.

## Section IV. DISASSEMBLY OF TELESCOPE ASSEMBLY

### 119. Removal of Front Telescope Cover

*a.* Unscrew the six fillister-head screws (fig. 107) and lock washers from the front telescope cover and pry off the cover to break the seal between the housing and the cover.

*b.* Remove the six round-point set screws from the injection sealing ports (par. 56) and clean the sealing compound from the front telescope cover and the housing (par. 63). Insert a brass wire in the sealing ports to loosen the compound.

### 120. Removal of Side Telescope Cover

*a.* Unscrew the five fillister-head screws and lock washers from the side telescope cover (fig. 107) and pry off the cover to break the seal between the housing and the cover.

*b.* Remove the seven round-point set screws from the injection sealing ports (par. 56), and clean the sealing compound from the cover and the housing (par. 63). Insert a brass wire into the sealing ports to loosen the compound.

### 121. Removal of Collective Lens Cover and Pipe Plug

*a.* Unscrew the two fillister-head screws (fig. 107) that hold each of the two collective lens covers to the tube and lift off the covers.

*b.* Unscrew the pipe plug from the tube.

### 122. Removal of Eyepiece Assembly

Unscrew the six socket-head screws (fig. 107) and lock washers that secure the eyepiece assembly to the lower housing. Pry off the eyepiece assembly to break the seal between the lower housing and the assembly.

### 123. Removal of Lower Housing

*a.* Unscrew the seven socket-head screws (fig. 108) and lock washers that secure the lower to the upper housing. Pry the lower housing from the upper housing to break the seal.

*b.* Remove the four flat-point set screws from the sealing ports of the upper housing (par. 56).

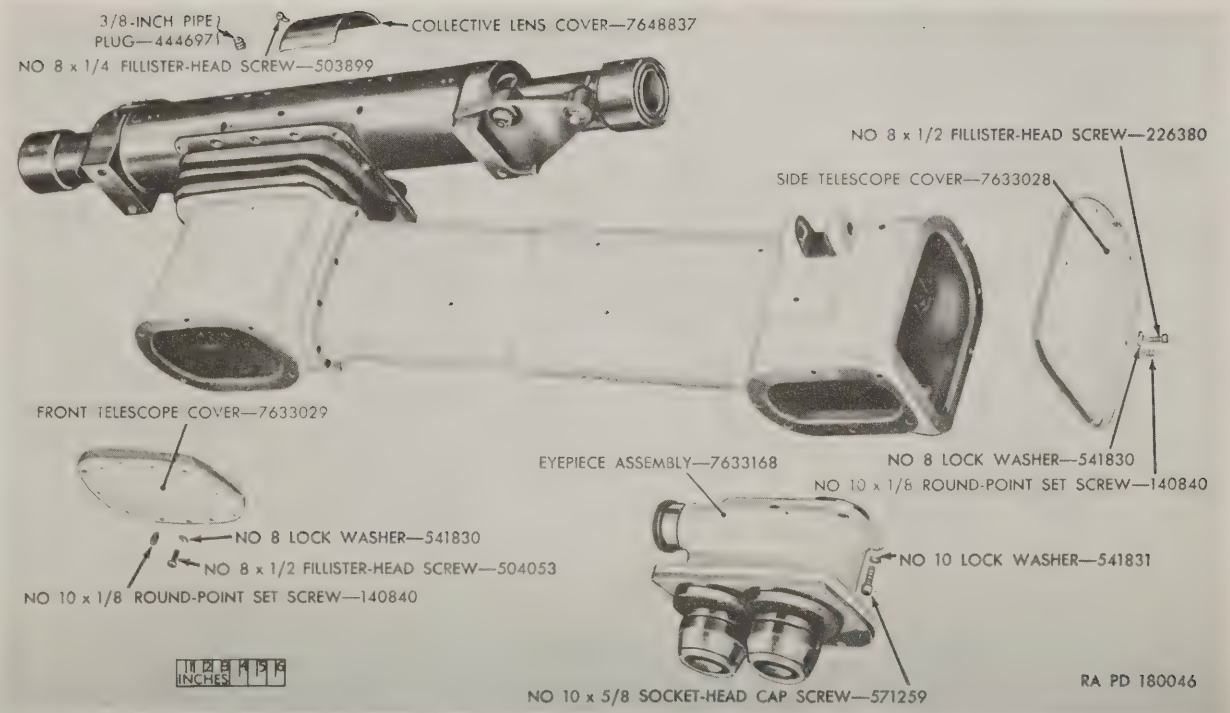

3/8-INCH PIPE PLUG—444697
COLLECTIVE LENS COVER—7648837
NO 8 x 1/4 FILLISTER-HEAD SCREW—503899
NO 8 x 1/2 FILLISTER-HEAD SCREW—226380
SIDE TELESCOPE COVER—7633028
FRONT TELESCOPE COVER—7633029
EYEPIECE ASSEMBLY—7633168
NO 8 LOCK WASHER—541830
NO 10 x 1/8 ROUND-POINT SET SCREW—140840
NO 8 LOCK WASHER—541830
NO 8 x 1/2 FILLISTER-HEAD SCREW—504053
NO 10 x 1/8 ROUND-POINT SET SCREW—140840
NO 10 LOCK WASHER—541831
NO 10 x 5/8 SOCKET-HEAD CAP SCREW—571259
INCHES
RA PD 180046

*Figure 107. Removal of front and side telescope covers, collective lens cover, pipe plug, and eyepiece assembly.*

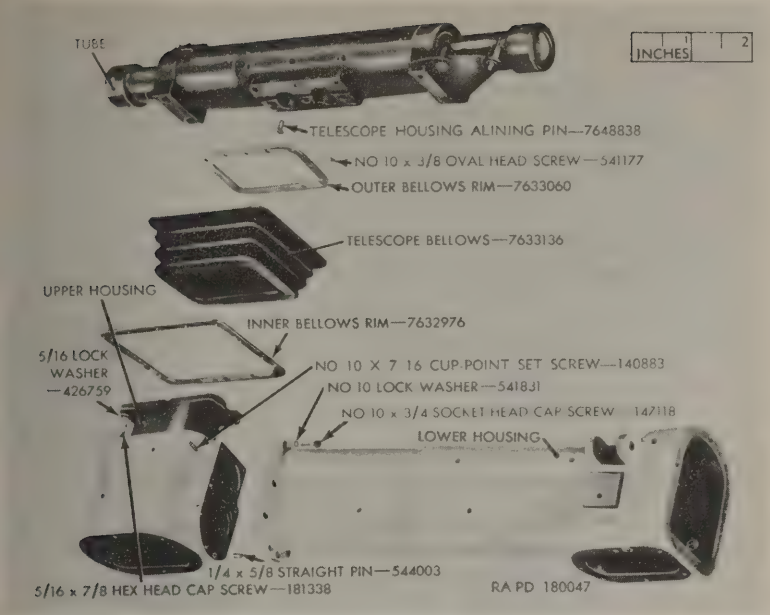

TUBE
INCHES
TELESCOPE HOUSING ALINING PIN—7648838
NO 10 x 3/8 OVAL HEAD SCREW—541177
OUTER BELLOWS RIM—7633060
TELESCOPE BELLOWS—7633136
UPPER HOUSING
INNER BELLOWS RIM—7632976
5/16 LOCK WASHER —426759
NO 10 X 7 16 CUP-POINT SET SCREW—140883
NO 10 LOCK WASHER—541831
NO 10 x 3/4 SOCKET HEAD CAP SCREW—147118
LOWER HOUSING
1/4 x 5/8 STRAIGHT PIN—544003
5/16 x 7/8 HEX HEAD CAP SCREW—181338
RA PD 180047

*Figure 108. Removal of lower and upper housings.*

*c.* Pull the straight pin from the upper housing and clean the sealing compound from the contact surfaces of both housings (par. 63). Use a brass wire in the sealing ports to loosen the sealing compound.

## 124. Removal of Upper Housing and Related Parts

*a.* Compress the telescope bellows (fig. 108) over the upper housing, unscrew the four hex-head screws and lock washers that secure the upper housing to the tube, and pull the upper housing from the tube.

*b.* Pull the alining pin from the drilled hole in the tube mounting surface, and unscrew the twelve oval-head screws that secure the outer and inner bellows rims and the bellows to the upper housing. Pull the bellows and the rims from the housing.

## 125. Removal of Eyepiece Adapter, Cell Assembly, and Related Parts

*a.* Unscrew the three fillister-head screws (fig. 109) and plain washers that secure the eyepiece adapter to the eyepiece seal. Remove two flat-point special screws and four flat-point set screws from the injection sealing ports in the adapter. Pull the two straight pins from the eyepiece adapter.

*b.* Remove two flat point set screws from the eyepiece index and slide the index from the diopter scale adapter.

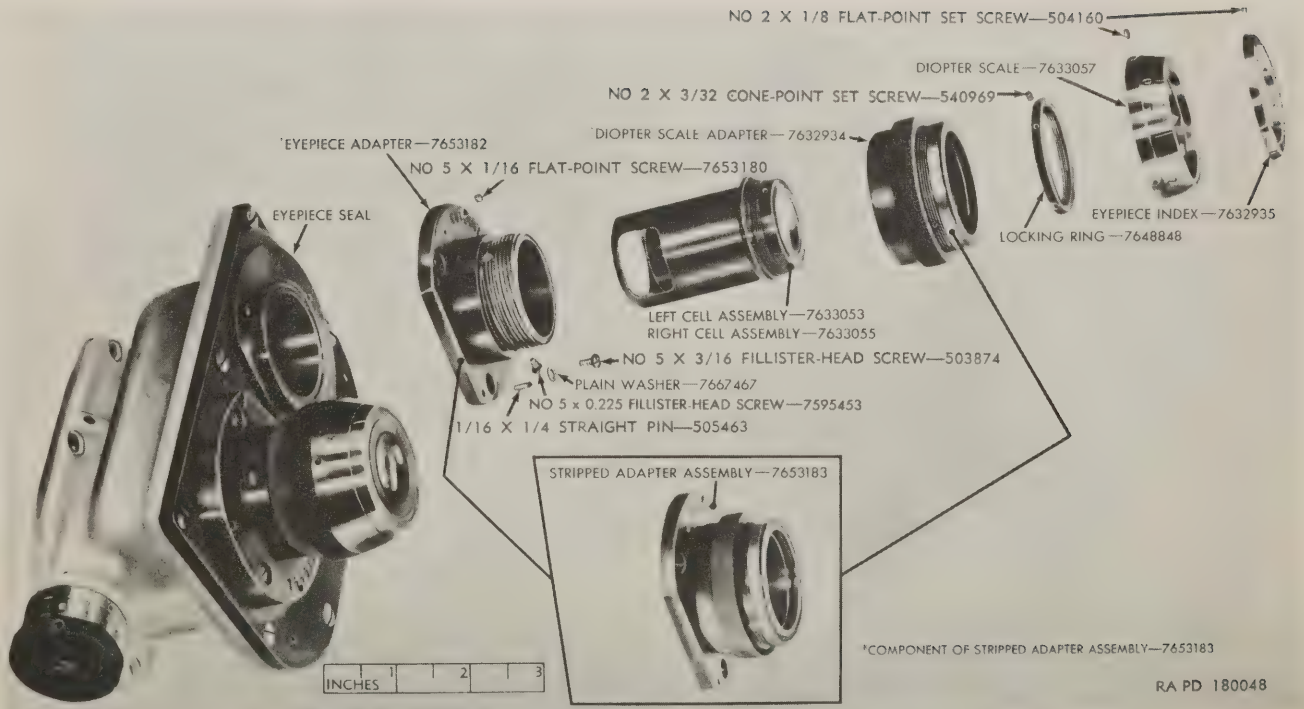



*Figure 109. Removal of eyepiece adapter, cell assembly, and related parts.*

*c.* Remove three flat-point set screws from the diopter scale and slide the diopter scale from the diopter scale adapter.

*d.* Remove one cone-point set screw from the locking ring. Unscrew the locking ring from the cell assembly and unscrew the diopter scale adapter from the eyepiece adapter.

*e.* Remove the cell assembly (fig. 109) from the eyepiece adapter.

*f.* Clean the sealing compound from the contact surfaces of the adapter, the seal and the sealing ports (par. 63) using a brass wire to clean the sealing compound from the ports.

## 126. Removal of Eyepiece Cover and Related Parts

*a.* Unscrew the slotted nut (fig. 110) from the eyepiece adapter using an improvised 2⅛-inch hook spanner wrench (fig. 48). Pry the seal from the cover. Pull off the gasket carefully to avoid damage.

*b.* Unscrew the seven oval-head screws from the cover, pry the cover from the eyepiece housing, and clean the sealing compound from the seal, gasket, cover, and the mounting surface of the eyepiece housing (par. 63).

## 127. Removal of Interpupillary Adjustment Knob and Related Parts

*a.* Drive the taper pin (fig. 111) from the knob (par. 59*a*) and pull the knob from the shaft.

*b.* Remove one cone-point set screw that secures the interpupillary scale to the knob (par. 56) and slide the scale from the knob.

*c.* Remove one cone-point set screw that secures the scale index to the housing and slide the index from the eyepiece housing.

## 128. Removal of Interpupillary Adjustment Knob Shaft Assembly

*a.* Unscrew the three fillister-head screws (fig. 112) and lock washers that secure the shaft assembly to the housing.

*b.* Insert a screwdriver into the slot of the knob end of the shaft, and turn the shaft clockwise until the shaft threads disengage from the interpupillary nut of the left eyepiece adapter.

*c.* Scribe lines on the shaft collar and the shaft bearing (par. 55*d*) so that the same threads of the shaft and the nut will be engaged when assembling.

*d.* Remove the shaft assembly completely from the eyepiece housing and pull the two straight pins from the eyepiece housing.

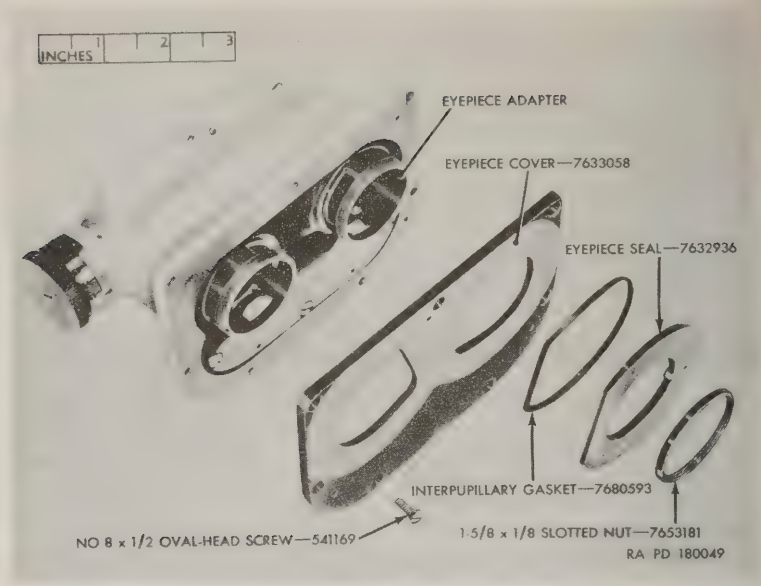



***Figure 110. Removal of eyepiece cover and related parts.***

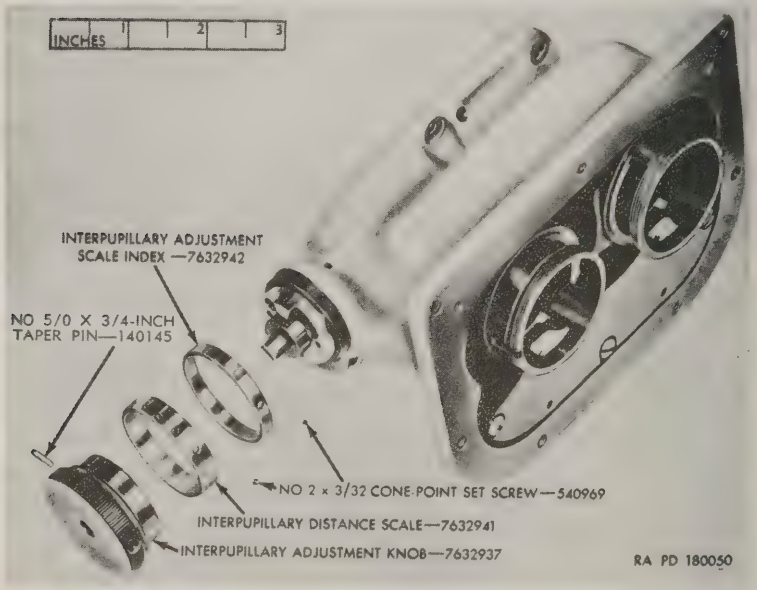



*Figure 111. Removal of interpupillary adjustment knob and related parts.*

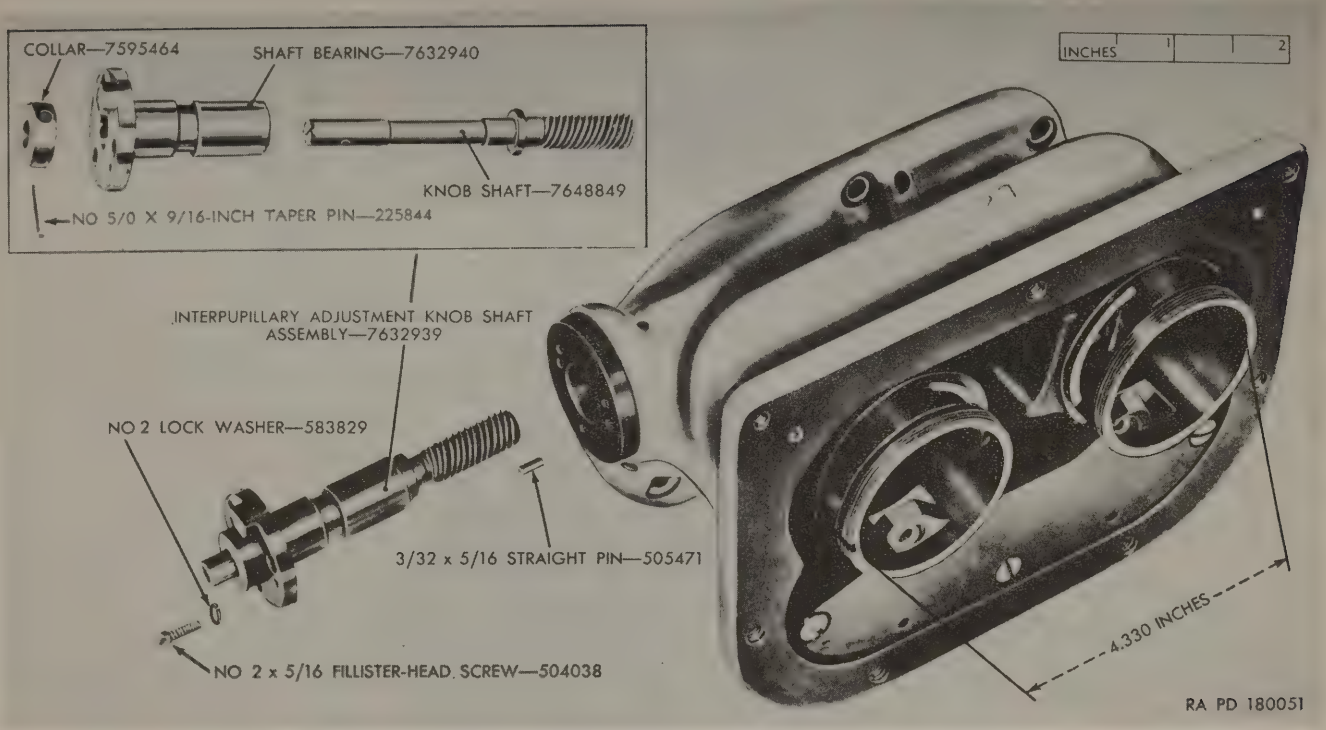



*Figure 112. Removal of interpupillary adjustment knob shaft assembly.*

## 129. Removal of the Eyepiece Support and Related Parts

*a.* Unscrew the three fillister-head screws (fig. 113) from the eyepiece support. Pull the support with both the right and the left eyepiece adapters from the eyepiece housing. Drive out the two riveted shoulder pins from the support and remove the eyepiece adapters from the support.

*b.* Lift the interpupillary connecting nut from the yoke of the left eyepiece adapter.

*c.* Remove the two straight pins from the eyepiece housing.

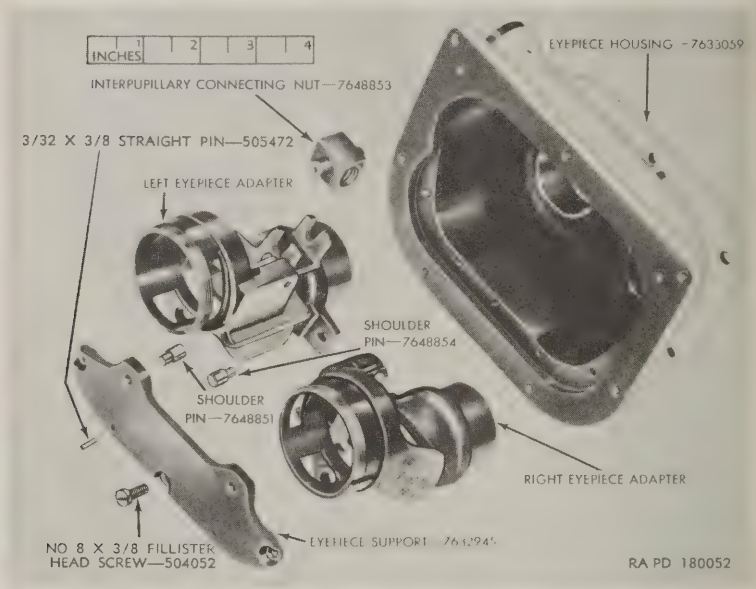



*Figure 113. Removal of the eyepiece support and related parts.*

## 130. Removal of 90° Prism Bracket Assembly from Upper Housing

*a.* Unscrew the three fillister-head screws (fig. 114) that secure the bracket assembly to the upper housing, and pull the bracket assembly from the upper housing through the cover opening.

*b.* Lift the prism adjusting eccentric from the drilled hole in the housing and remove the flat-point set screw from the threaded prism adjustment hole in the housing (par. 56).

*c.* Clean the sealing compound from the set screw and the threads of the adjusting hole (par. 63).

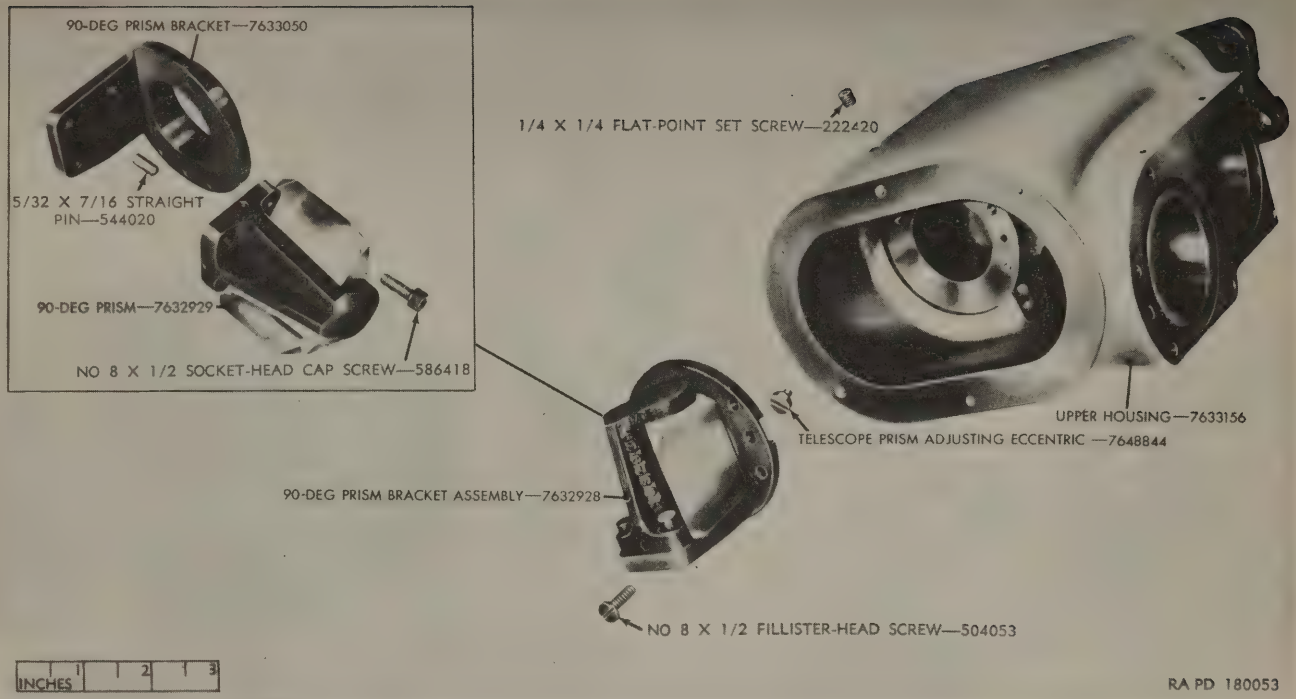

90-DEG PRISM BRACKET—7633050
5/32 X 7/16 STRAIGHT PIN—544020
90-DEG PRISM—7632929
NO 8 X 1/2 SOCKET-HEAD CAP SCREW—586418
1/4 X 1/4 FLAT-POINT SET SCREW—222420
UPPER HOUSING—7633156
TELESCOPE PRISM ADJUSTING ECCENTRIC —7648844
90-DEG PRISM BRACKET ASSEMBLY—7632928
NO 8 X 1/2 FILLISTER-HEAD SCREW—504053
INCHES
RA PD 180053

*Figure 114. Removal of 90° prism bracket assembly from upper housing.*

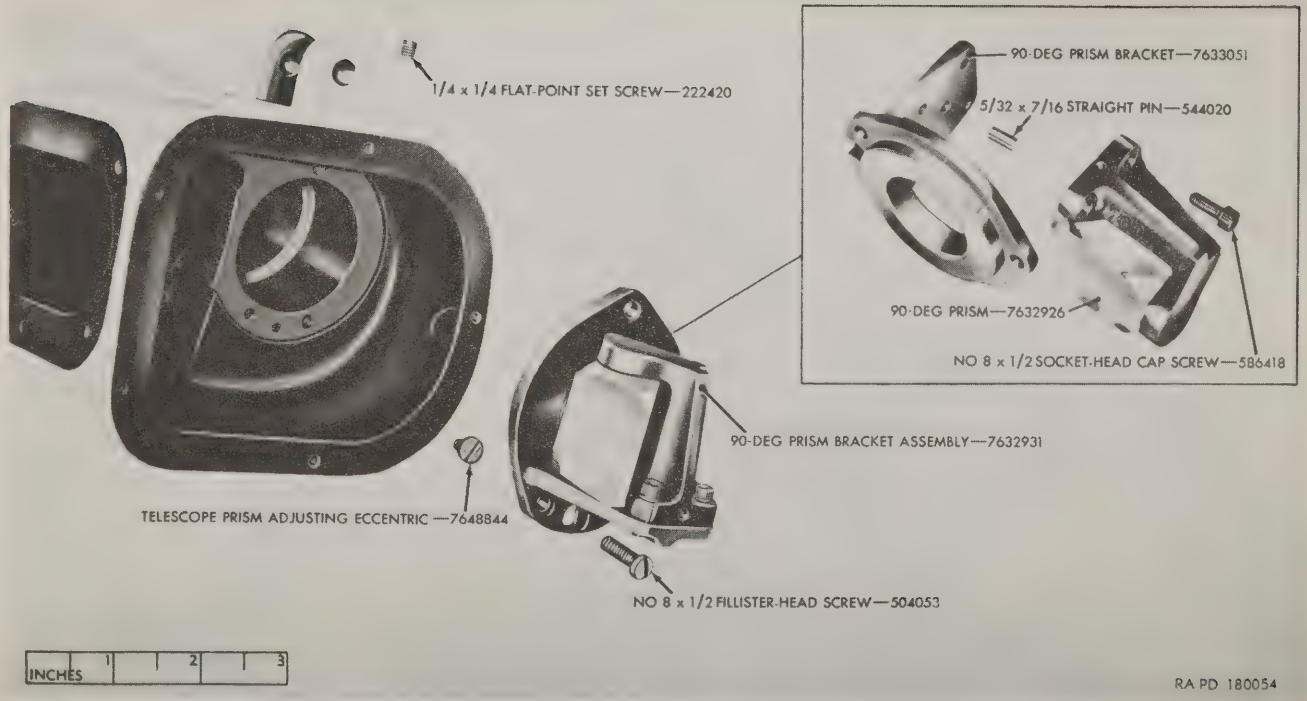



*Figure 115. Removal of 90° prism bracket assembly from lower housing.*

## 131. Removal of 90° Prism Bracket Assembly from Lower Housing

*a.* Unscrew the three fillister-head screws (fig. 115) that secure the bracket assembly to the lower housing and pull the bracket assembly from the housing through the cover opening.

*b.* Remove the flat-point set screw from the prism adjustment hole in the housing and lift the prism adjusting eccentric from the drilled hole in the housing.

*c.* Clean the sealing compound from the set screw and the threads of the adjusting hole (par. 63).

*Figure 116. Removal of erector cell assemblies.*

## 132. Removal of Erector Cell Assemblies

Remove the two cone-point set screws (fig. 116) from the threaded adjustment holes in the lower housing (par. 56) that engage the flutes of the two erector cell assemblies. Unscrew the short erector cell assembly using the focusing wrench 7659139 (fig. 117) and unscrew the long erector cell assembly using the telescope wrench 7659126 (fig. 118).

319437 O—54——10

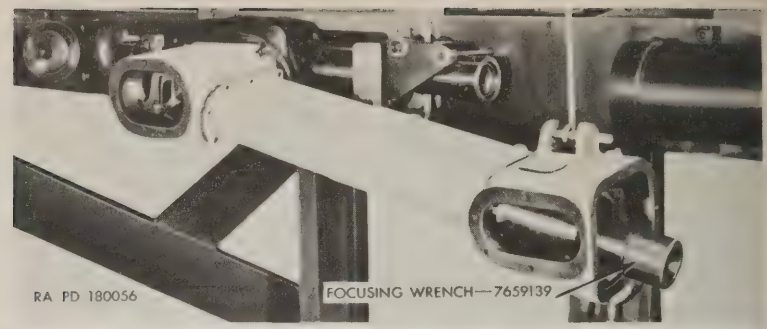



*Figure 117. Use of the focusing wrench 7659139 for removing short erector cell assembly.*

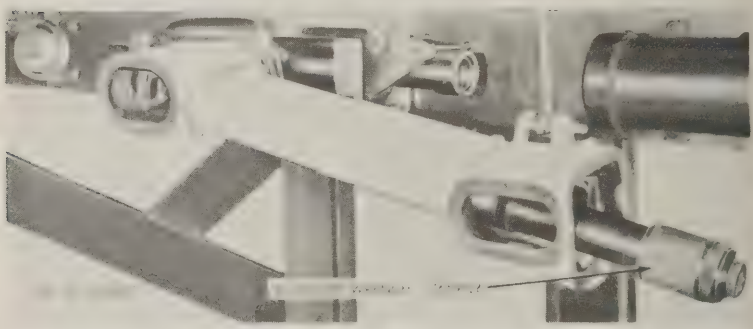


*Figure 118. Use of the telescope wrench 7659126 for removing long erector cell assembly.*

## 133. Removal of Segment Gear, Objective Lens Cell Assembly, and Related Parts

*a.* Unscrew the two fillister-head screws (fig. 119) and lock washers from the segment gear, lift the segment gear from the tube, and pull the straight pin from the tube.

*b.* Unscrew the retaining ring from the adapter (par. 60) using a tubular wrench 41–W–3726–240, remove the four flat-point set screws from the adapter (par. 56), and slide out the cell adapter and the objective lens cell assembly as a unit from the adapter (par. 60*b*). Repeat the same procedure for the right end of the tube.

*c.* Remove the two flat-point set screws from the cell adapter and slide the cell assembly from the adapter cell.

## 134. Removal of Telescope Mounting Bearing and Related Parts

*a.* Remove the cone-point set screw (fig. 120) from the gear (par. 56) and unscrew the adapter using strap wrench 41–W–3382 (fig. 14)

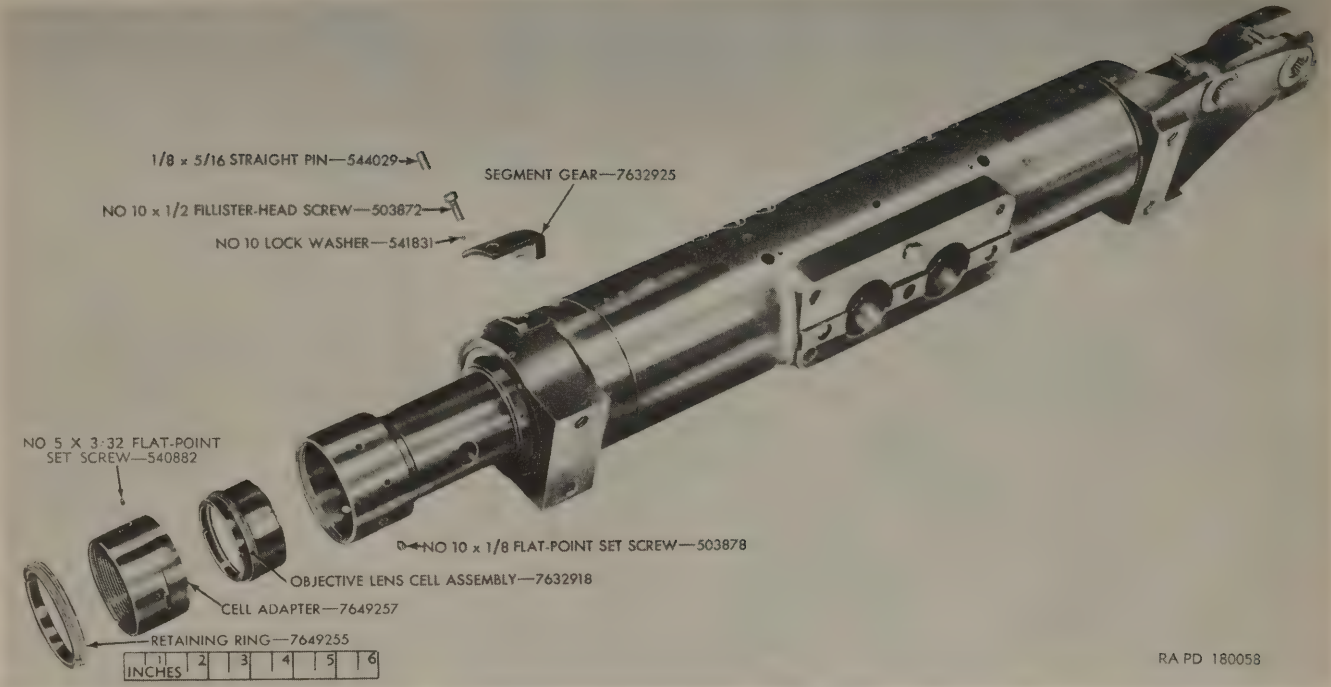

1/8 x 5/16 STRAIGHT PIN—544029
SEGMENT GEAR—7632925
NO 10 x 1/2 FILLISTER-HEAD SCREW—503872
NO 10 LOCK WASHER—541831
NO 5 X 3-32 FLAT-POINT SET SCREW—540882
NO 10 x 1/8 FLAT-POINT SET SCREW—503878
OBJECTIVE LENS CELL ASSEMBLY—7632918
CELL ADAPTER—7649257
RETAINING RING—7649255
INCHES 1 2 3 4 5 6
RA PD 180058

*Figure 119. Removal of segment gear, objective lens cell assembly and related parts.*

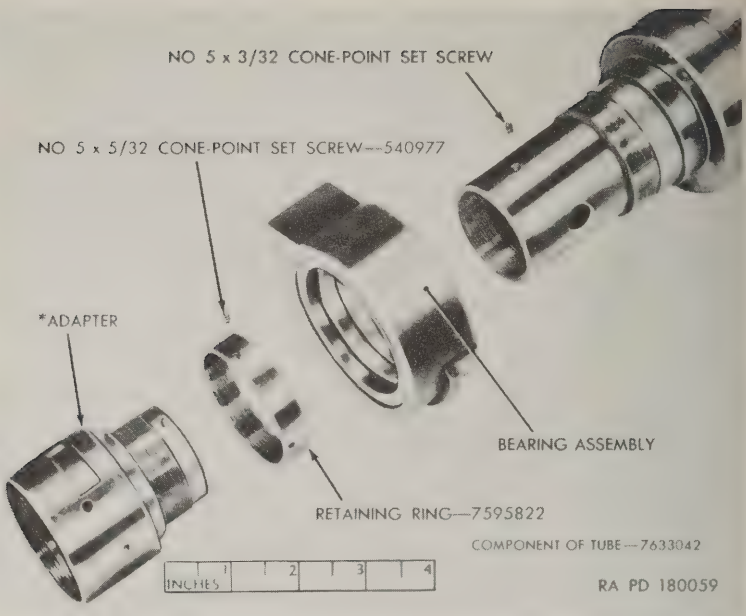



*Figure 120. Removal of telescope mounting bearing and related parts.*

on the adapter and an improvised 0.477-inch bar wrench (fig. 45) in the holes of the gear to keep the gear from turning.

*b.* Remove the cone-point set screw from the retaining ring and unscrew the retaining ring from the gear (par. 60) using an improvised single pin-type spanner wrench (fig. 55). Slide the bearing assembly from the gear.

## 135. Removal of Telescope Bearing Housing Assembly

*a.* Remove the cone-point set screw (fig. 121) from the tube (par. 56) and unscrew the adapter from the tube using strap wrench 41–W–3382 (fig. 14) on the adapter and the improvised 0.477-inch bar wrench (fig. 45) in the holes of the tube to keep the tube from turning.

*b.* Slide the telescope bearing housing assembly from the tube.

## 136. Removal of Gear and Tube

Remove the two cone-point set screws (fig. 122) from the larger tube (par. 56) and screw off the gear and the smaller tube using strap wrench 41–W–3382 (fig. 14) to hold the large tube and the improvised 0.477-inch bar wrench to turn the gear and small tube.

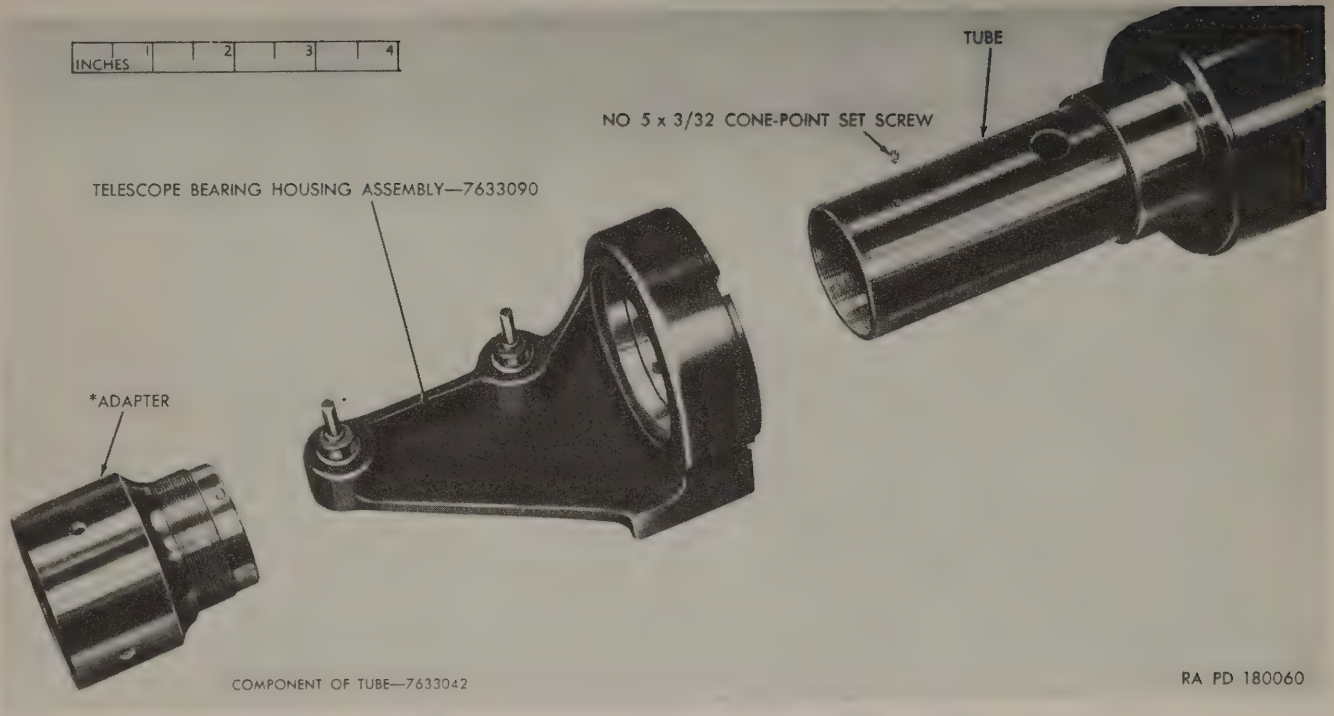



*Figure 121. Removal of telescope bearing housing assembly.*

### 137. Removal of Prism Differential Assembly and Prism Support Assembly

*a.* Remove the two cone-point set screws (fig. 123) from the tube (par. 56) and unscrew one retaining ring from each end of the tube (par. 60) using the improvised 2.7-inch pin-type spanner wrench (fig. 53).

*b.* Remove the four cup-point set screws from the tube and slide the support assembly and the differential assembly from the tube.

### 138. Removal of Prism and Collective Lens Assembly

Unscrew the three fillister-head screws (fig. 124) that secure the prism with lens assembly to the tube and slide the assembly from the tube.

### 139. Disassembly of Eyepiece Cell Assembly

*a.* Pull the lens diaphragm (fig. 125) from the cell after loosening the diaphragm by using tubular wrench 41–W–3726–98 to break the seal of the sealing compound.

*b.* Mark the optical elements during disassembly (par. 61*d*) to establish correct sequence and direction of the components of the assembly.

*c.* Slide a thin blade between the eyepiece cell and the field lens, the separator, and the eyelens to break the seal of the sealing compound and remove the field lens, separator, and eyelens (par. 61*b*).

*d.* Clean the sealing compound from the cell, diaphragm, lenses, and the separator (par. 63).

### 140. Disassembly of Interpupillary Adjustment Knob Shaft Assembly

Drive the taper pin (fig. 112) from the collar (par. 59*a*) and slide the collar and the shaft bearing from the knob shaft.

### 141. Disassembly of Left Eyepiece Adapter

Unscrew the two fillister-head screws (fig. 126) that secure the prism to the left eyepiece adapter and pull the prism and the straight pins from the adapter.

### 142. Disassembly of Right Eyepiece Adapter

*a.* Unscrew the two fillister-head screws (fig. 127) that secure the prism to the right eyepiece adapter and pull the prism and straight pins from the adapter.

### 143. Disassembly of 90° Prism Bracket Assemblies

Unscrew the three socket-head screws (figs. 114 and 115) from each 90° prism, pull the prisms from the brackets, and pull a straight pin from each bracket.

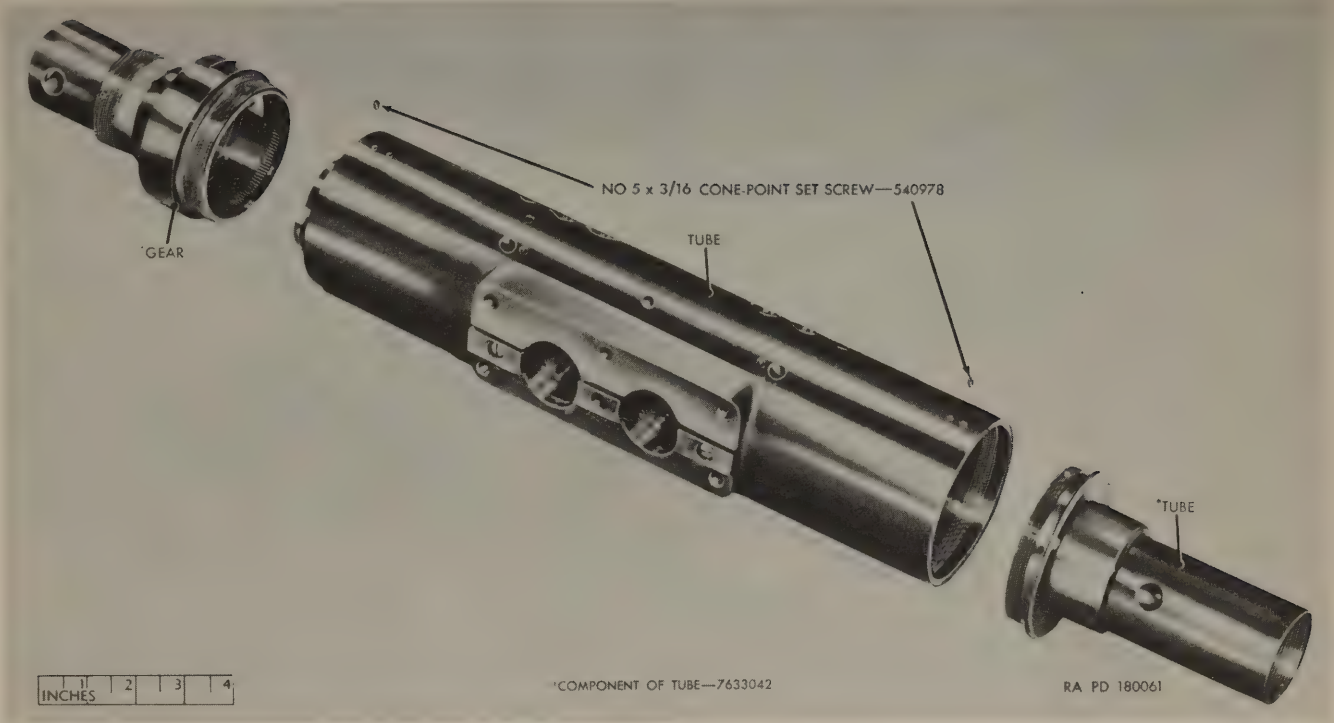



*Figure 122. Removal of gear and tube.*

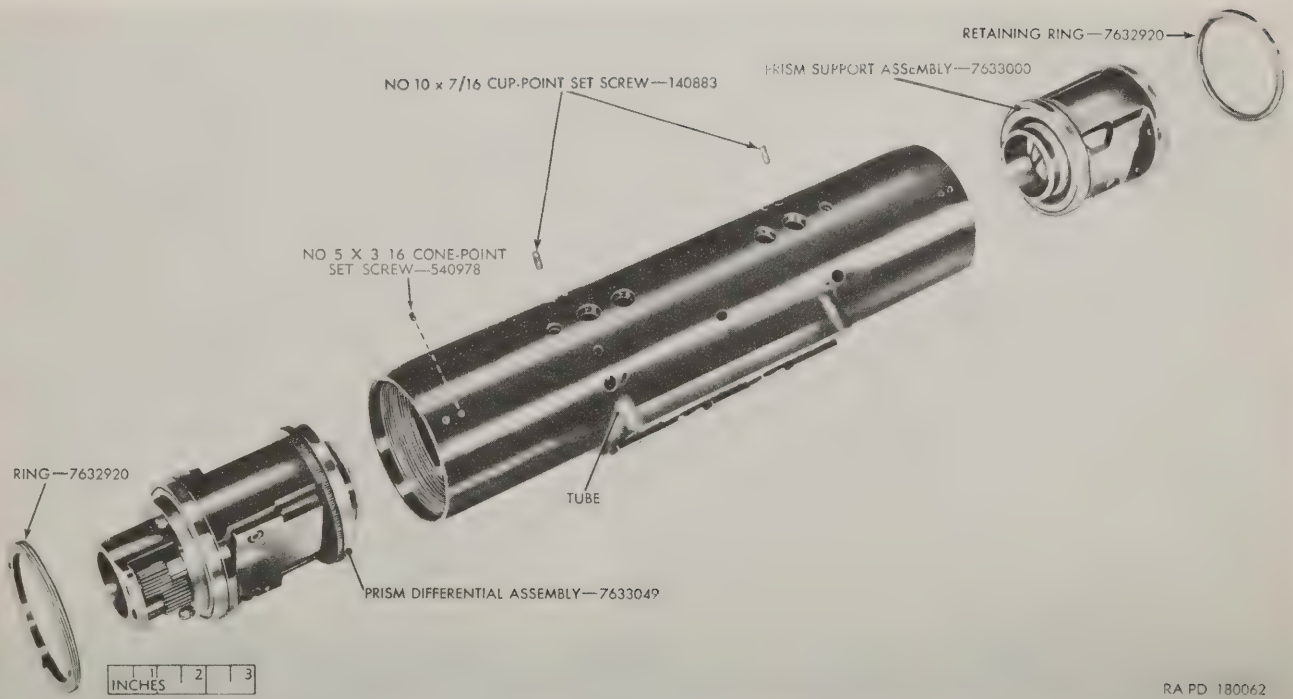



*Figure 123. Removal of prism differential assembly and prism support assembly.*

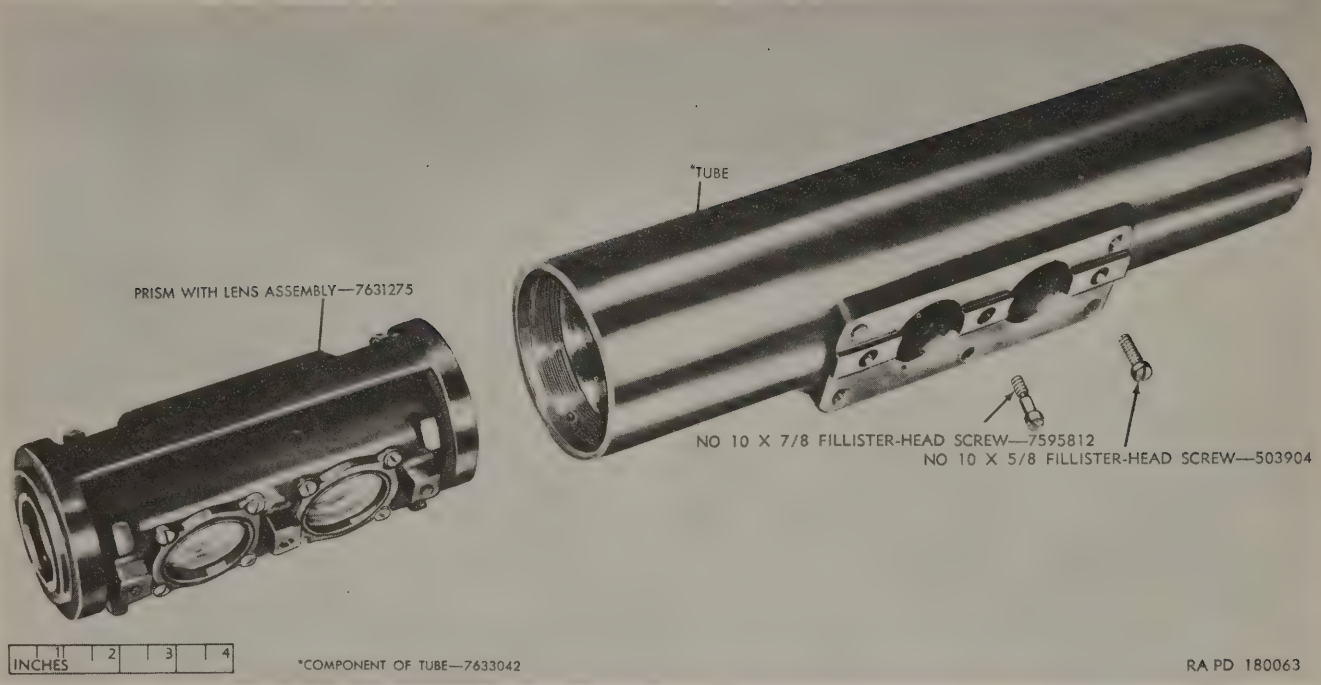



*Figure 124. Removal of prism and collective lens assembly.*

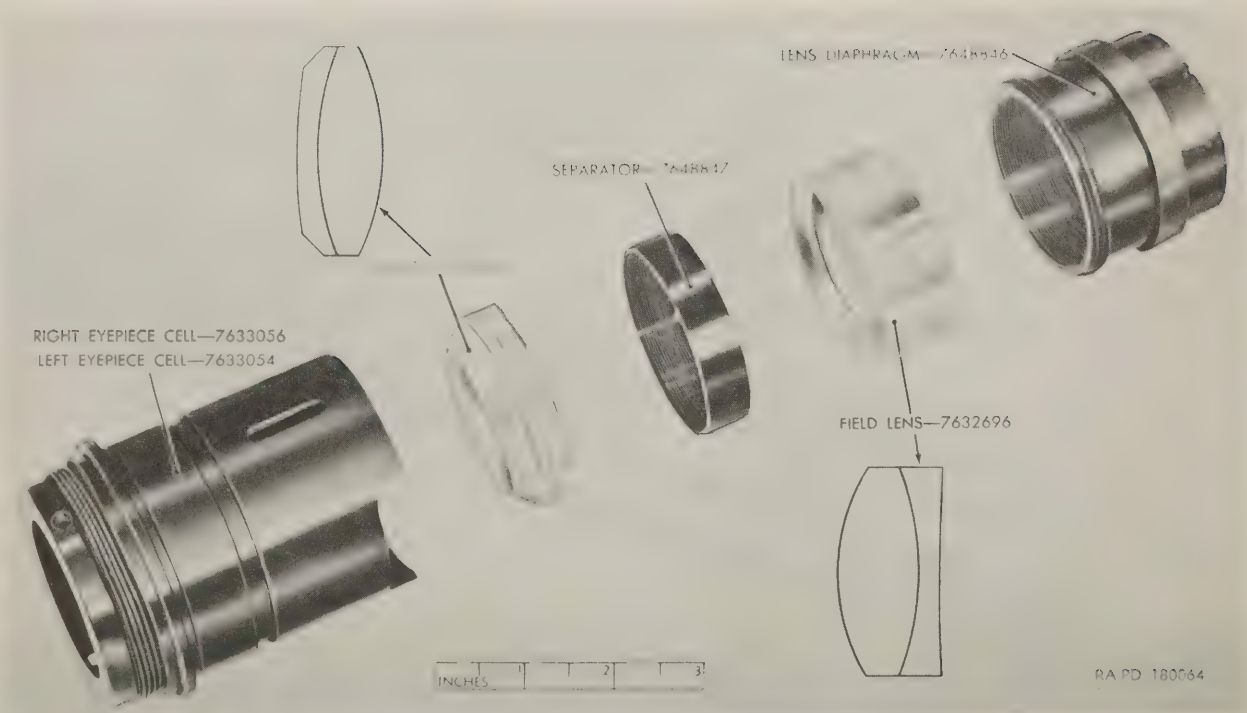



*Figure 125. Eyepiece cell assembly—exploded view.*

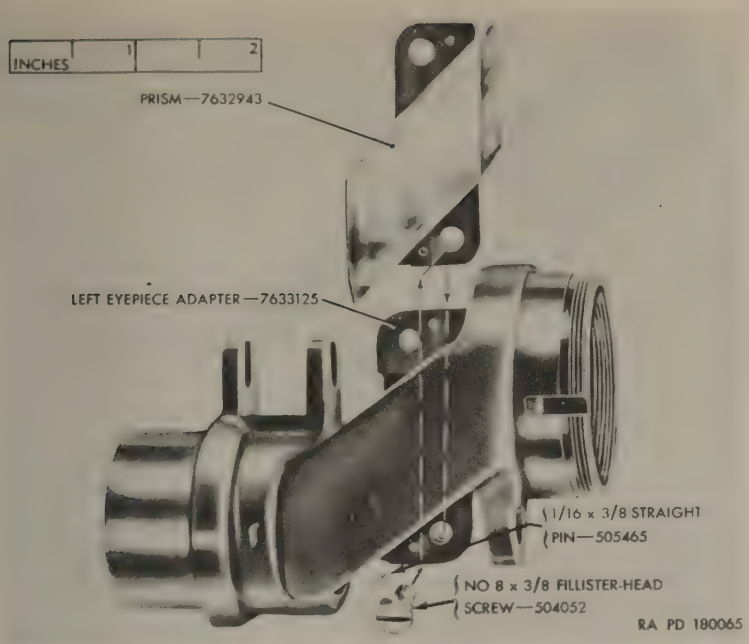



*Figure 126. Left eyepiece adapter—exploded view.*

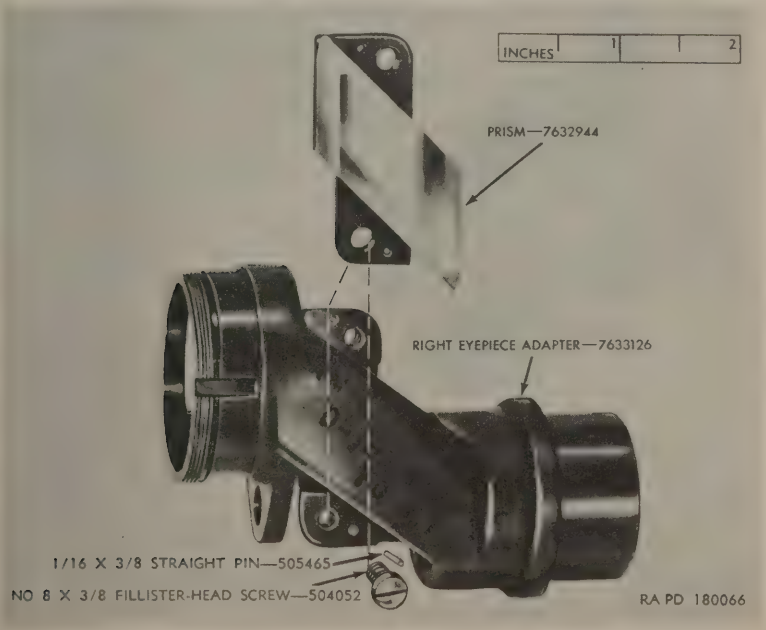



*Figure 127. Right eyepiece adapter—exploded view.*

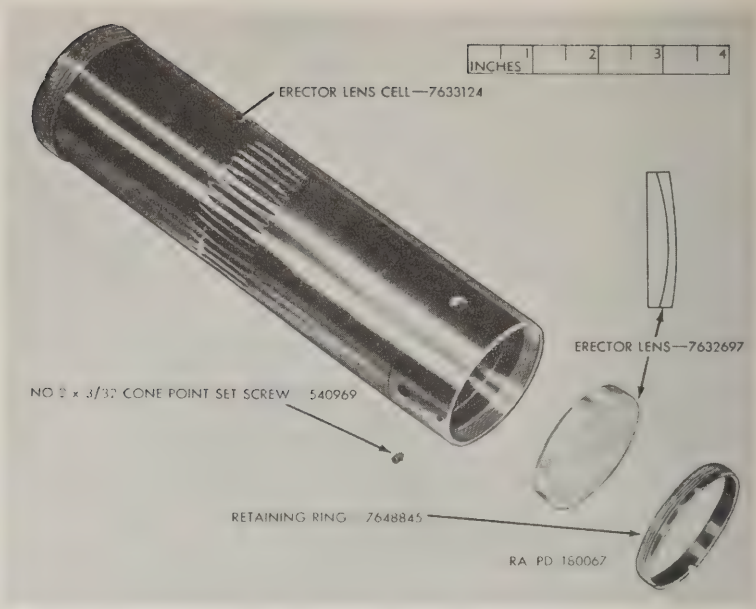



*Figure 128. Erector cell assembly—exploded view.*

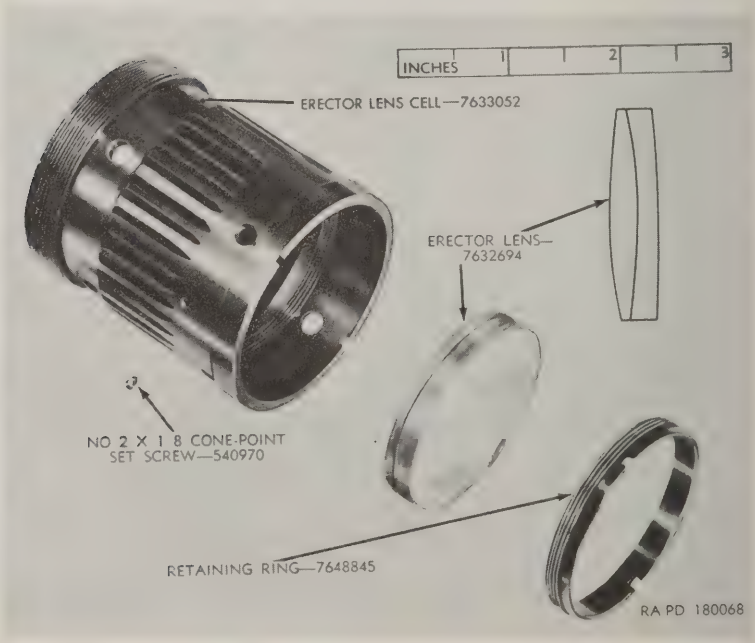



*Figure 129. Erector cell assembly—exploded view.*

## 144. Disassembly of Erector Cell Assemblies

*a.* Remove a cone-point set screw (figs. 128 and 129) that secures each retaining ring to its erector cell, and unscrew the retaining ring from the cell (par. 60) using tubular wrench 41–W–3726–183.

*b.* Remove the erector lens from each cell (par. 61*b*) marking properly to facilitate reassembly (par. 61*d*).

## 145. Disassembly of Objective Lens Cell Assembly

Unscrew the retaining ring (fig. 130) from the cell (par. 60) using tubular wrench 41–W–3726–170. Remove the lens from the cell (par. 61*b*) marking (par. 61*d*) for reassembly. Clean the sealing compound from the cell and the lens (par. 63).

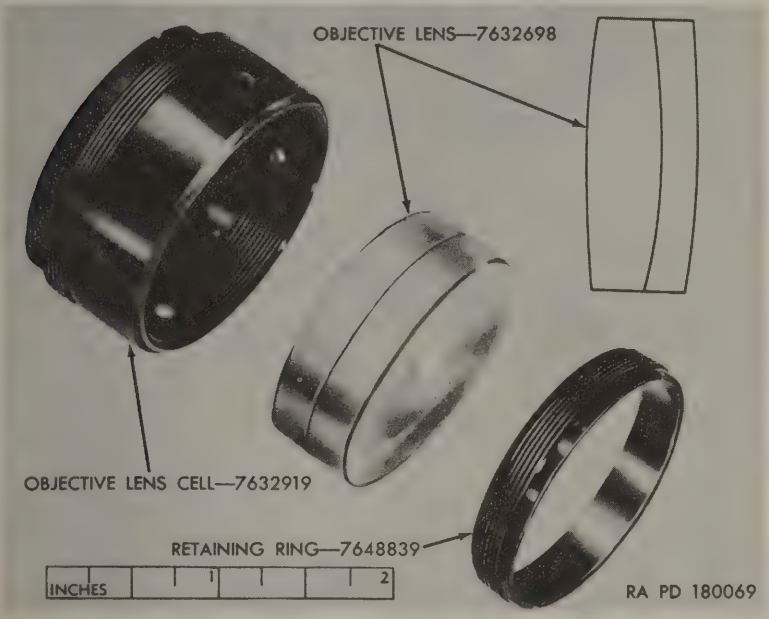



*Figure 130. Objective lens cell assembly—exploded view.*

## 146. Disassembly of Telescope Mounting Bearing and Related Parts

Remove the cone-point set screw (fig. 131) from the telescope mounting bearing (par. 56), unscrew the retaining ring from the bearing (par. 60) using improvised 2.5-inch pin-type spanner wrench (fig. 52). Slide the two ball bearings from the telescope bearing.

## 147. Disassembly Telescope Bearing Housing Assembly

*a.* Remove the cone-point set screw (fig. 132) from the bearing housing (par. 56), unscrew the retaining ring from the housing (par. 60)

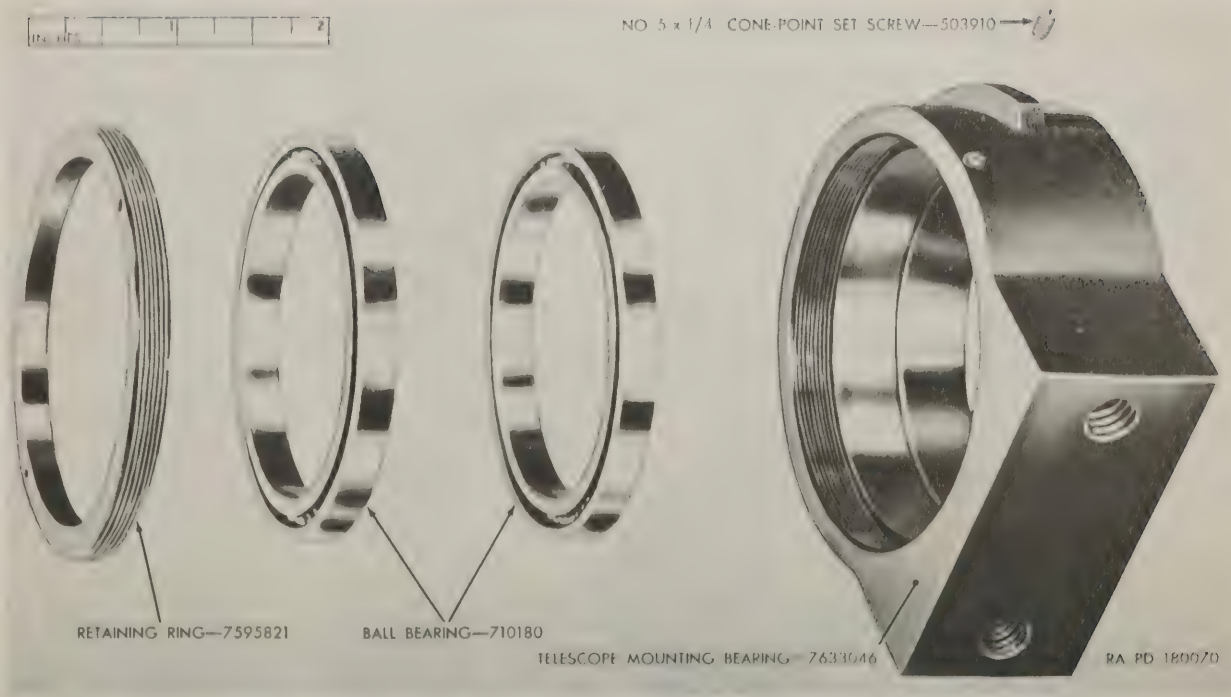



*Figure 131. Telescope mounting bearing with related parts.*

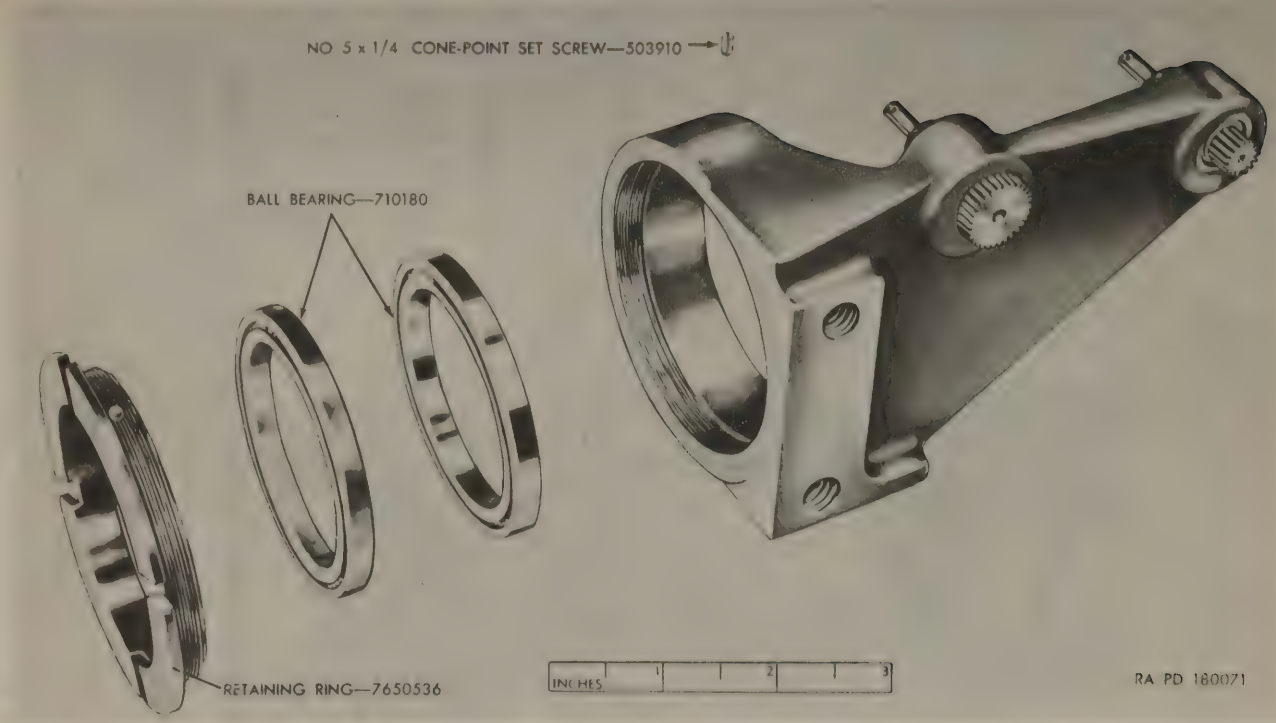



*Figure 132. Telescope bearing housing assembly—partially exploded view.*

using tubular wrench 41–W–3726–330. Tap out the two ball bearings from the housing.

*b.* Drive the taper pin (fig. 133) from the collar (par. 59*a*), unscrew the collar from the spur gear and slide the gear from the housing.

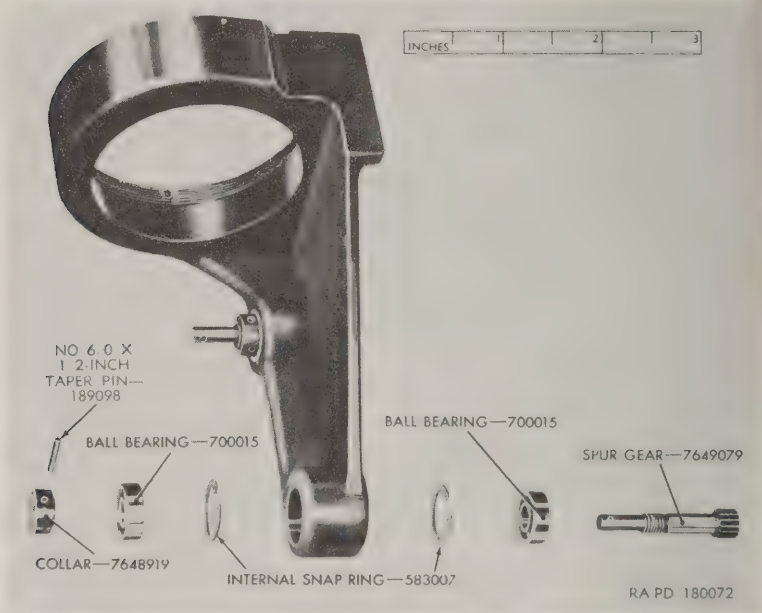



*Figure 133. Telescope bearing housing assembly—partially exploded view.*

*c.* Tap the two ball bearings from the housing, compress the two snap rings using snap ring pliers, and lift the rings from the recesses in the housing.

*d.* Follow the same procedure in the removal of the other spur gear (fig. 134).

## 148. Disassembly of the Prism Differential Assembly

*a.* Unscrew the three fillister-head screws (fig. 135) and lock washers that secure the prism differential spider assembly to the prism support assembly. Pull the spider assembly from the support assembly.

*b.* Pull the straight pin from the support assembly.

*c.* Drive the two straight pins (fig. 136) from the tube retainer of the spider assembly and lift out the two spur pinions.

*d.* Remove the staking and tap out the staked liner tube.

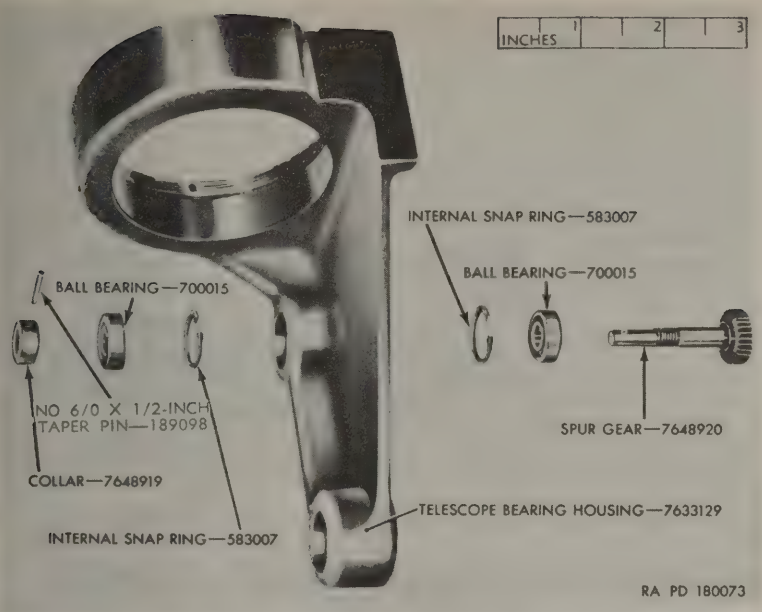



*Figure 134. Telescope bearing housing assembly—partially exploded view.*

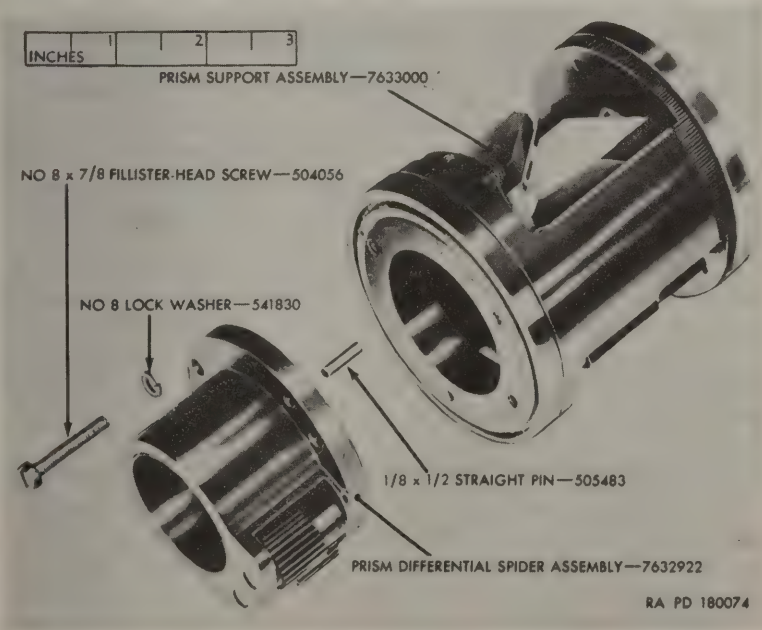

INCHES 1 2 3
PRISM SUPPORT ASSEMBLY—7633000
NO 8 x 7/8 FILLISTER-HEAD SCREW—504056
NO 8 LOCK WASHER—541830
1/8 x 1/2 STRAIGHT PIN—505483
PRISM DIFFERENTIAL SPIDER ASSEMBLY—7632922
RA PD 180074

*Figure 135. Prism differential assembly—exploded view.*

319437 O—54——11

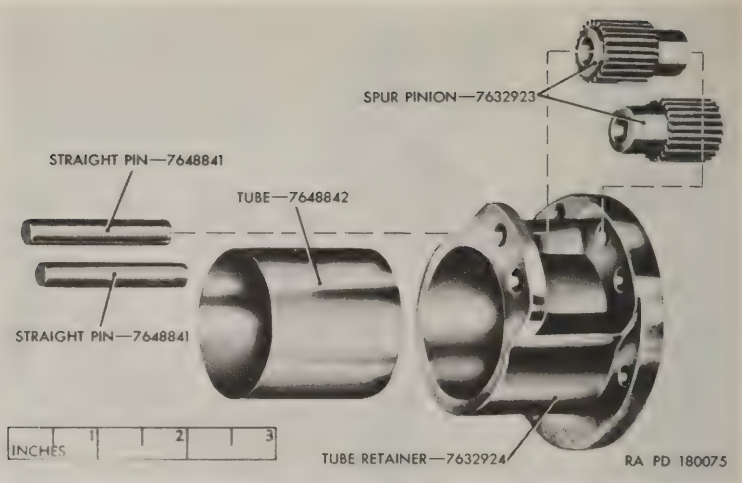



*Figure 136. Prism differential spider assembly—exploded view.*

## 149. Disassembly of the Prism Support Assembly

*a.* Slide the two ball bearings (fig. 137) from the prism support and unscrew, from each prism, two socket-head screws that secure the prisms to the support.

*b.* Pull the two prisms and the four straight pins from the support.

## 150. Removal of Prism and Collective Lens Assemblies

*a.* Remove the two flat-point set screws (fig. 138) that secure the first collective lens cell assemblies to the holder assembly (par. 56). Unscrew the two collective lens cell assemblies from the holder assembly using tubular wrench 41–W–3726–150 and lift the holder assembly from the tube.

*b.* Unscrew the eight round-head screws (fig. 139) that secure the second collective lens cell assemblies to the 90° prism holder assembly and pull the two cell assemblies from the holder assembly.

*c.* Unscrew the three fillister-head screws (fig. 140) that secure each 90° prism to the holder. Pull the two prisms from the holder and punch out the two straight pins.

## 151. Disassembly of the First Collective Lens Cell Assembly

*a.* Unscrew the retaining ring (fig. 141) from the cell (par. 60) using tubular wrench 41–W–3726–113. Remove the first collective lens from the cell (par. 61*b*) and mark for identification (par. 61*d*) in reassembly.

*b.* Clean the sealing compound from the lens, the retaining ring, and the cell (par. 63).

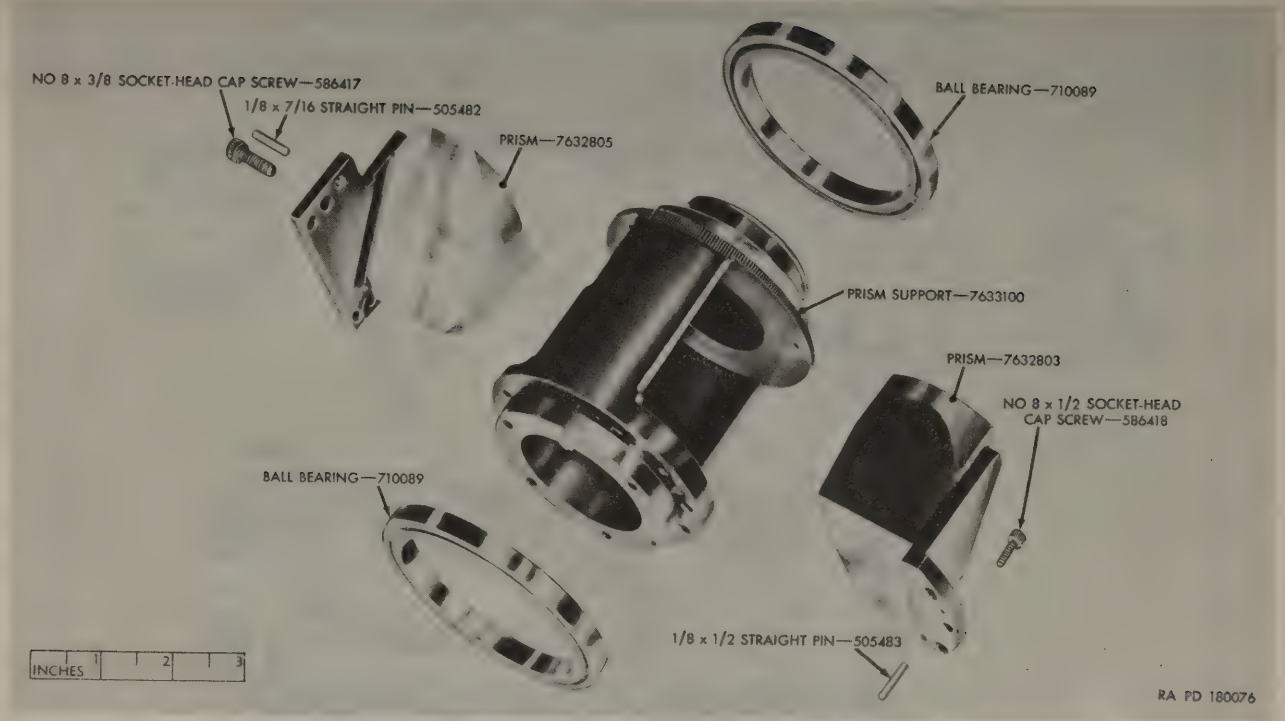



*Figure 137. Prism support assembly—exploded view.*

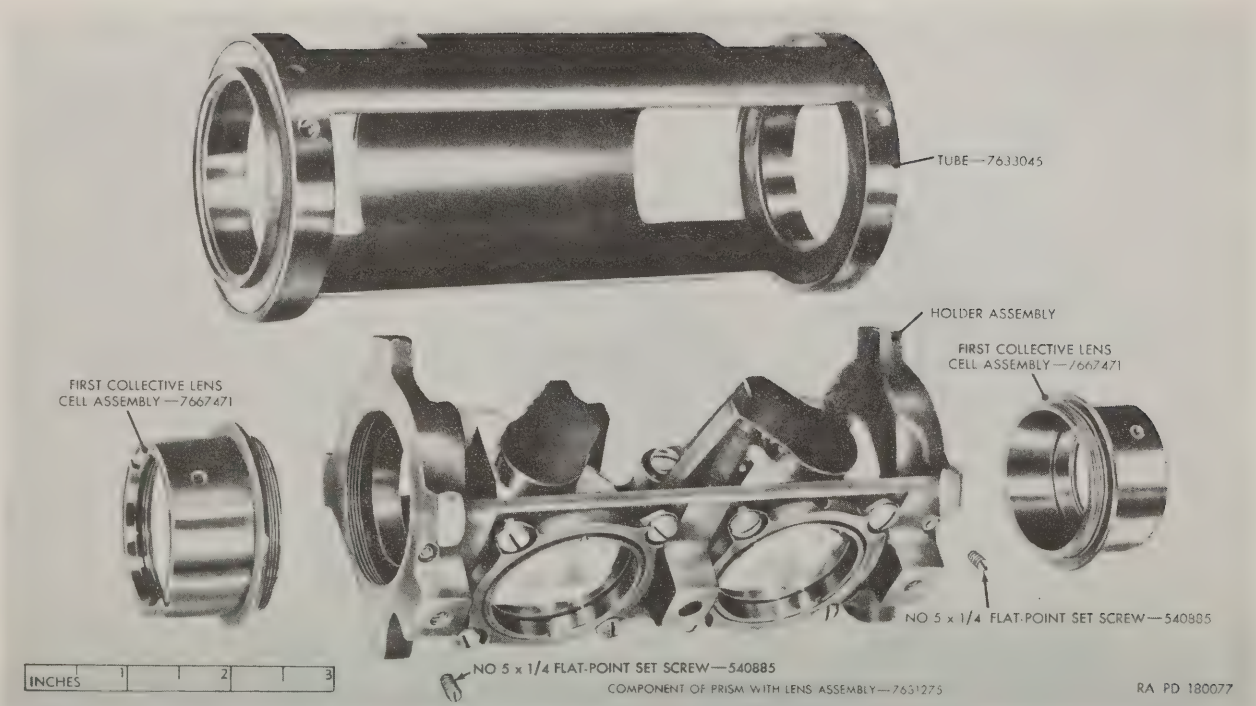

TUBE—7633045
HOLDER ASSEMBLY
FIRST COLLECTIVE LENS CELL ASSEMBLY—7667471
FIRST COLLECTIVE LENS CELL ASSEMBLY—7667471
NO 5 x 1/4 FLAT-POINT SET SCREW—540885
NO 5 x 1/4 FLAT-POINT SET SCREW—540885
COMPONENT OF PRISM WITH LENS ASSEMBLY—7631275
INCHES 1 2 3
RA PD 180077

*Figure 138. Prism and collective lens assembly—partially exploded view.*

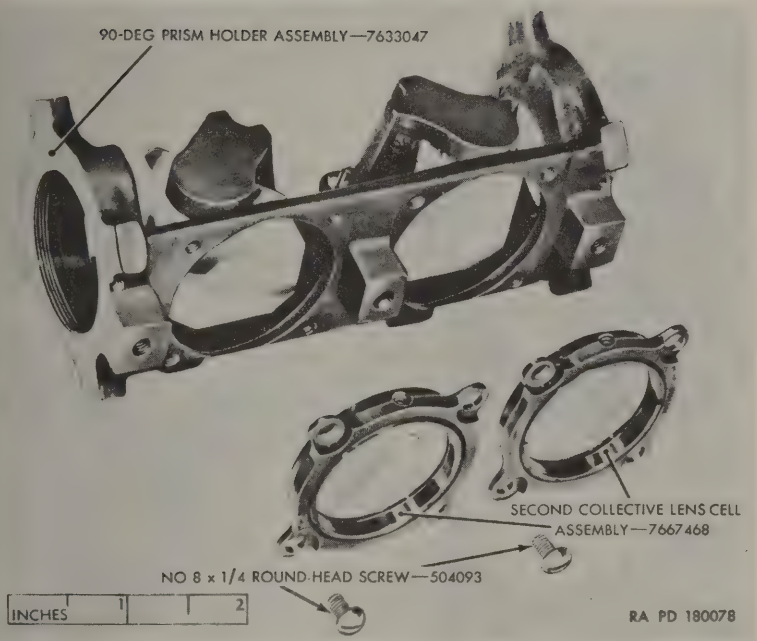



*Figure 139. Prism and collective lens assembly—partially exploded view.*

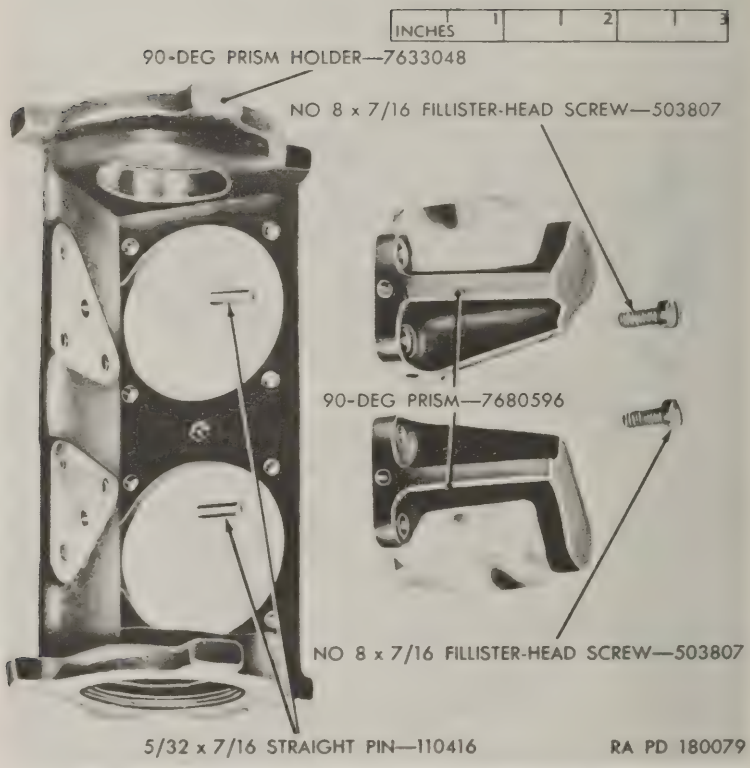

INCHES 1 2 3
90-DEG PRISM HOLDER—7633048
NO 8 x 7/16 FILLISTER-HEAD SCREW—503807
90-DEG PRISM—7680596
NO 8 x 7/16 FILLISTER-HEAD SCREW—503807
5/32 x 7/16 STRAIGHT PIN—110416
RA PD 180079

*Figure 140. Prism and collective lens assembly—partially exploded view.*

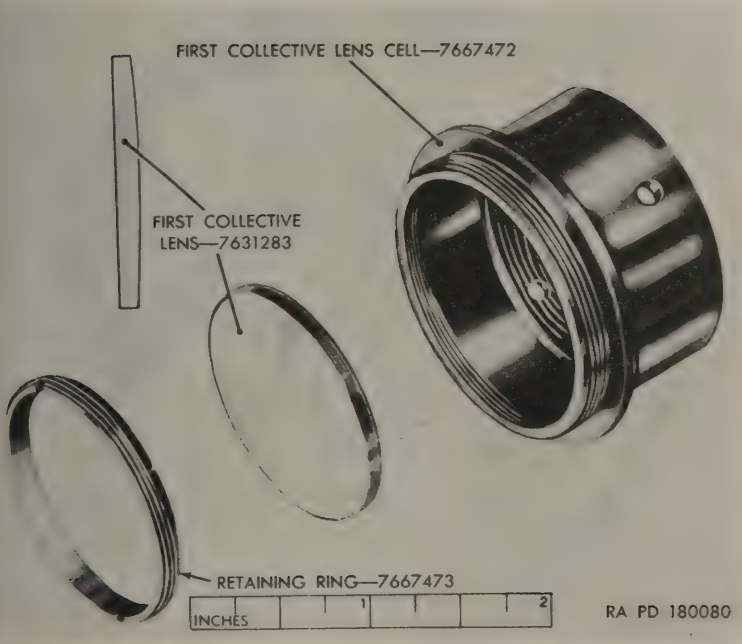



*Figure 141. First collective lens cell assembly—exploded view.*

### 152. Disassembly of Second Collective Lens Cell Assembly

Unscrew the retaining ring (fig. 142) from the second collective lens cell (par. 60) using tubular wrench 41–W–3726–143. Remove the second collective lens from the cell (par. 61*b*), mark for identification (par. 61*d*) for reassembly, and clean the sealing compound from the lens, the cell and the retaining ring (par. 63).

*Figure 142. Second collective lens cell assembly—exploded view.*

## Section V. DISASSEMBLY OF BALLISTIC CAM HOUSING ASSEMBLY (T41)

### 153. Removal of Ballistic Cam Housing Support Caps

Unscrew eight socket-head screws (fig. 143), and lock washers and pull the two ballistic cam housing support caps from the cam housing support.

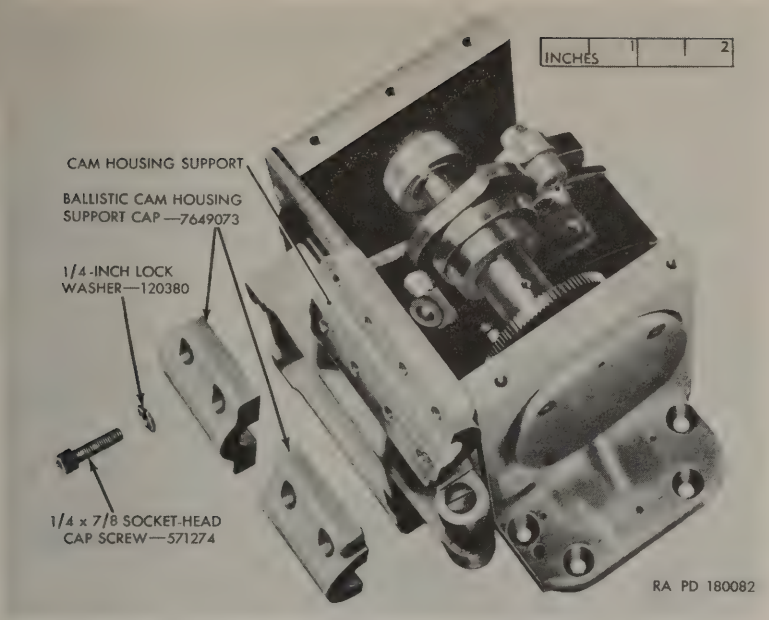



*Figure 143. Removal of ballistic cam housing support caps.*

## 154. Removal of Ballistic Cam Housing Cover, Ballistic Cam and Related Parts

*a.* Screw improvised holding screw 7662083 (fig. 144 )into the follower holder to relieve pressure from the lower cam follower. This will permit the extraction of the ballistic cam and the related parts.

*b.* Unscrew the four fillister-head screws (fig. 145) and lock washers from the cam housing cover. Pull the cover, with ballistic cam and related parts, from the housing; then remove the cover from the ballistic cam.

## 155. Removal of Level Vial Tube

*a.* Drive one straight pin from the cam housing support (fig. 146) and unscrew the slotted plug from the support.

*b.* Unscrew the four set screws from the tube.

*c.* Slide the level vial tube from the support and the vial cover will fall free.

## 156. Removal of Cam Housing Support and Related Parts

*a.* Unscrew the four socket-head screws from the housing (fig. 147) that secure one outer race of the cam housing bearing to the housing.

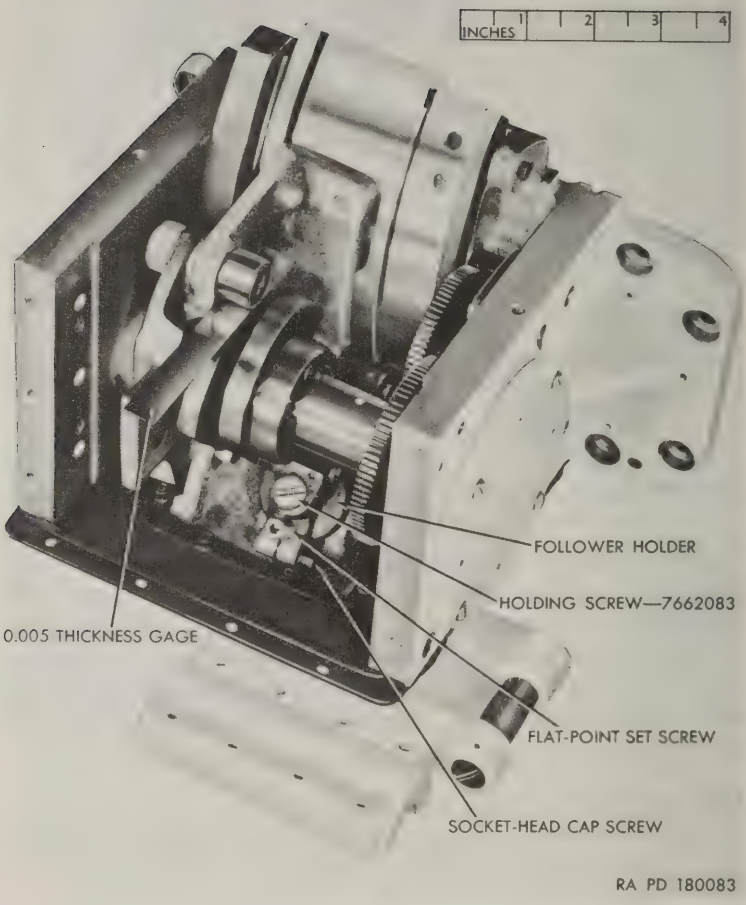



*Figure 144. Use of holding improvised screw 7662083.*

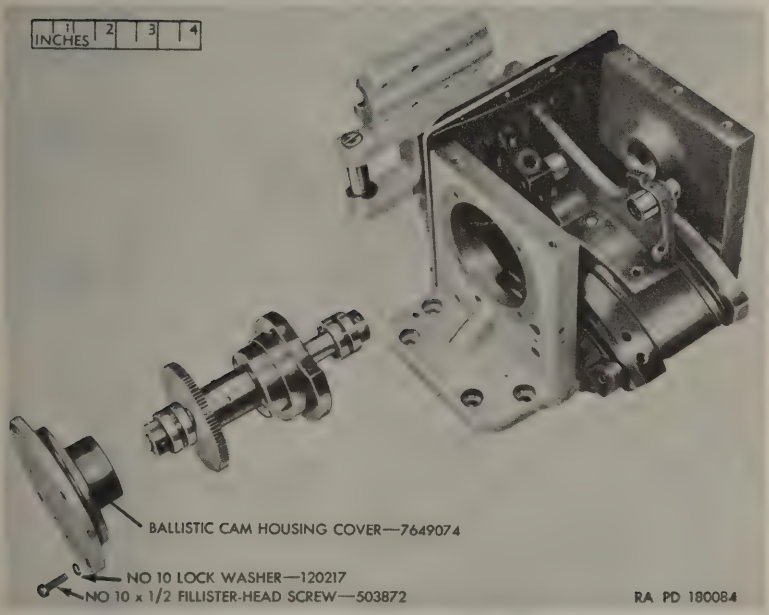

INCHES 1 2 3 4
BALLISTIC CAM HOUSING COVER—7649074
NO 10 LOCK WASHER—120217
NO 10 x 1/2 FILLISTER-HEAD SCREW—503872
RA PD 180084

*Figure 145. Removal of ballistic cam housing cover, ballistic cam, and related parts.*

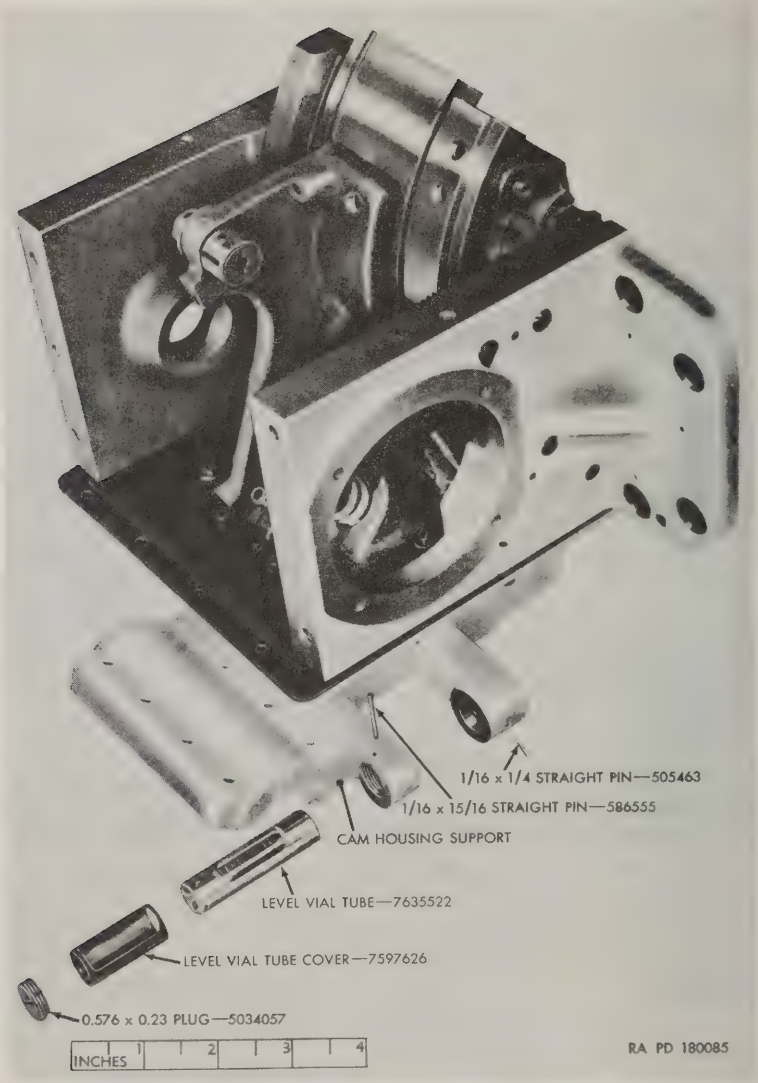



*Figure 146. Removal of level vial tube.*

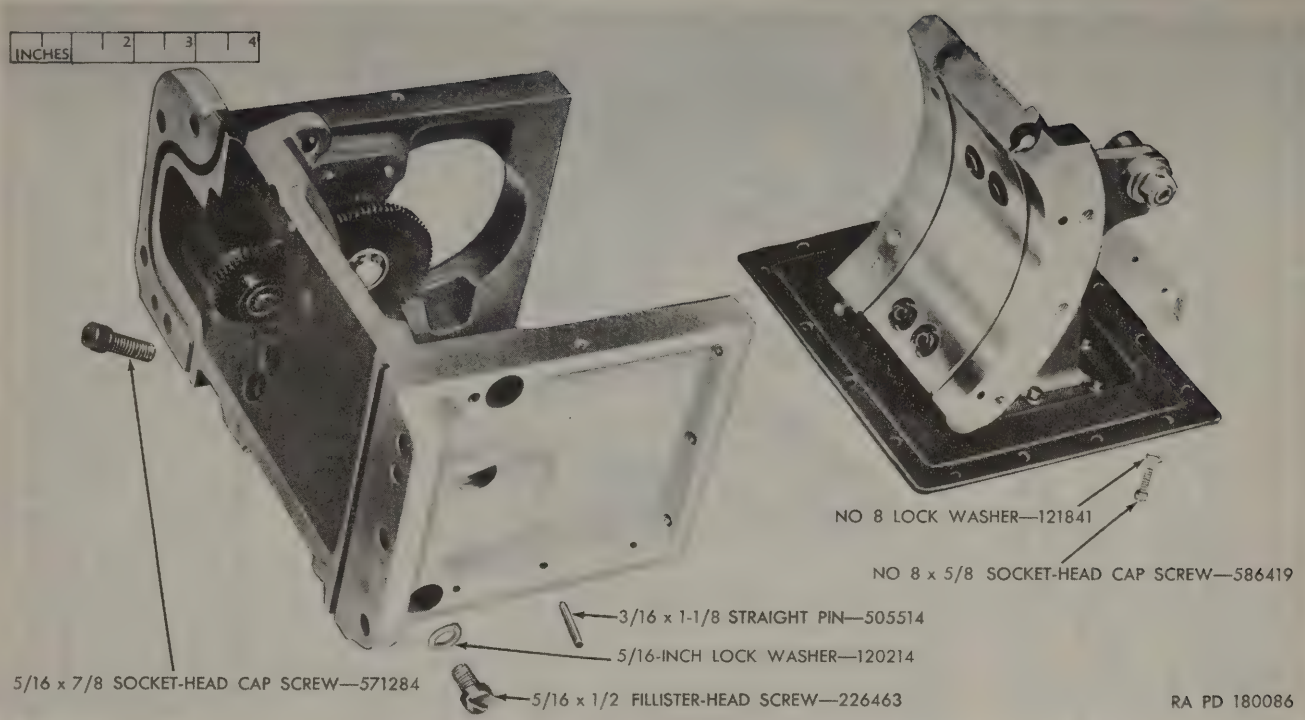



*Figure 147. Removal of cam housing support and related parts.*

*b.* Unscrew the three fillister-head screws and lock washers from the housing that secure the other outer race of the cam housing bearing to the housing.

*c.* Unscrew the eight remaining socket-head screws and lock washers that secure the rear bellows retaining plate and the bellows to the cam housing.

*Note.*—Eight screws and washers had previously been removed when cam housing was removed from the main housing.

*d.* Pull the cam housing support, with the cam housing bearing, bellows and two plates, from the cam housing.

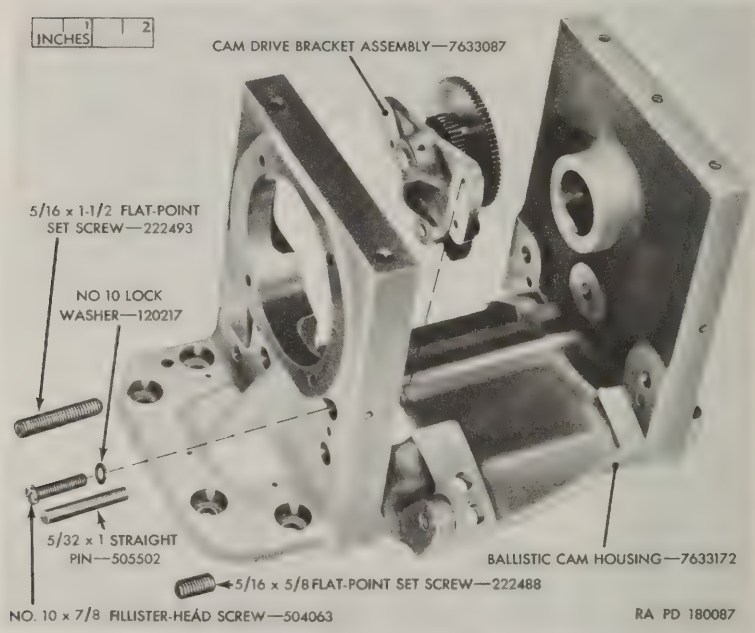

INCHES 1 2
CAM DRIVE BRACKET ASSEMBLY—7633087
5/16 x 1-1/2 FLAT-POINT SET SCREW—222493
NO 10 LOCK WASHER—120217
5/32 x 1 STRAIGHT PIN—505502
BALLISTIC CAM HOUSING—7633172
5/16 x 5/8 FLAT-POINT SET SCREW—222488
NO. 10 x 7/8 FILLISTER-HEAD SCREW—504063
RA PD 180087

*Figure 148. Removal of cam drive bracket assembly.*

## 157. Removal of Cam Drive Bracket Assembly

*a.* Unscrew the three fillister-head screws and lock washers from the cam housing (fig. 148) that secure the cam drive bracket assembly to the cam housing.

*b.* Lift the bracket assembly from the cam housing.

*c.* Unscrew the flat-point set screws from the cam housing that engaged the cam housing bearing through the housing.

*d.* Pull the two straight pins from the cam housing.

## 158. Disassembly of Ballistic Cam and Related Parts

*a.* Drive the taper pin (fig. 149) from the collar (par 59*a*), unscrew the collar from the shaft, and slide the two ball bearings and the spacer from the shaft.

*b.* Repeat the procedure at other end of the shaft (fig. 150).

*c.* Unscrew the three socket-head screws (fig. 151) and lock washers that secure the reverse and ballistic cams to the spur gear. Drive one straight pin from the gear.

*d.* Slide the cams from the shaft, punch the taper pin from the spur gear, and slide the gear from the shaft.

## 159. Disassembly of Cam Housing Support and Related Parts

*a.* Unscrew the ten socket-head screws (fig. 152) and lock washers that secure the front and rear bellows retaining plates and the bellows to the support. Remove both the plates and the bellows from the support.

*b.* Unscrew the four socket-head screws and washers that secure the middle race of the cam housing bearing to the support and pull the bearing from the support.

*c.* Drive the straight pin from the support and pull two straight pins (fig. 147) from the outer race.

*d.* Drive the taper pin (fig. 153) from the follower holder (par. 59*a*) and pull the stud from the support to free the holder from the support.

*e.* Lift the compression spring from the support recess. Punch the taper pin from the hex-nut, remove the nut and washer from the cam follower, and pull the cam follower from the support.

*f.* Drive the taper pin from the follower holder (fig. 154) and pull the cam follower from the holder.

*g.* Unscrew the socket-head screw and lock washer from the holder. Unscrew the flat-point set screw from the holder.

## 160. Disassembly of Cam Drive Bracket Assembly

*a.* Drive the taper pin (fig. 155) from the gear bracket and the stud (par. 59). Pull the stud from the bracket with the plain washer and the spur gear.

*b.* Slide the washer and gear from the stud (fig. 155). Tap the two ball bearings from the gear. Compress the two snap rings with snap ring pliers and lift the rings from the gear.

*c.* Repeat the procedure with stud 7648913 (fig. 156).

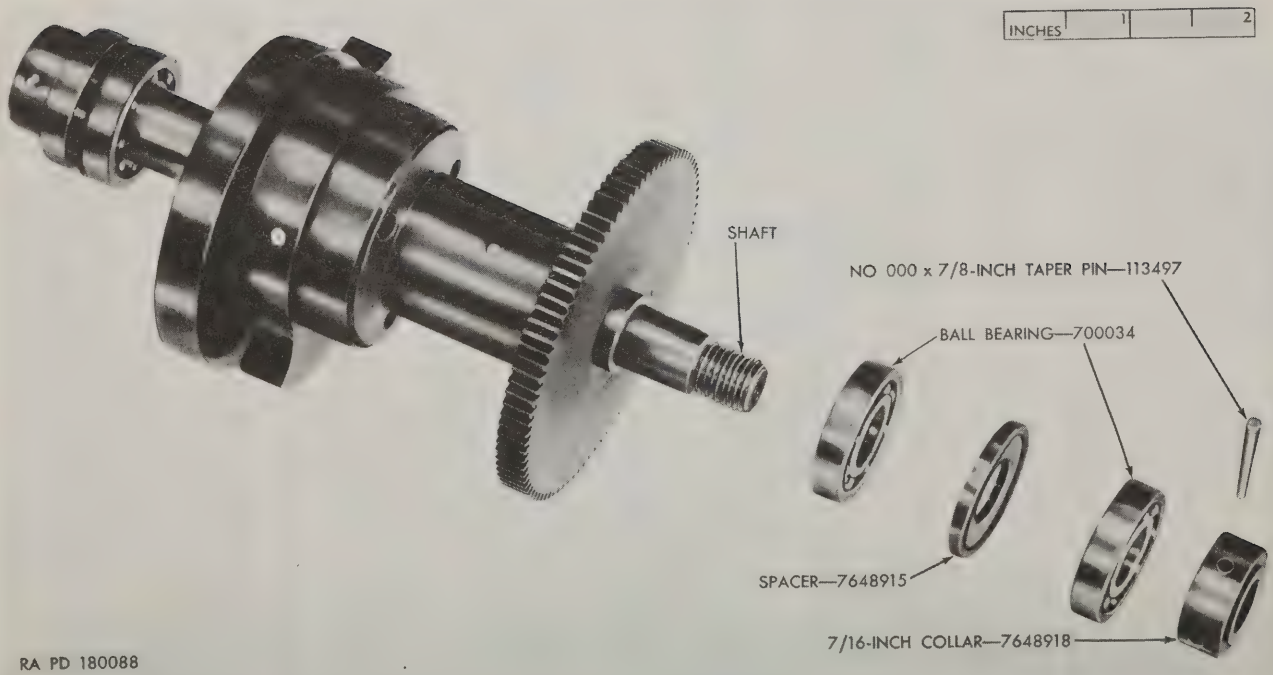



*Figure 149. Ballistic cam and related parts—partially exploded view.*

319437 O—54——12

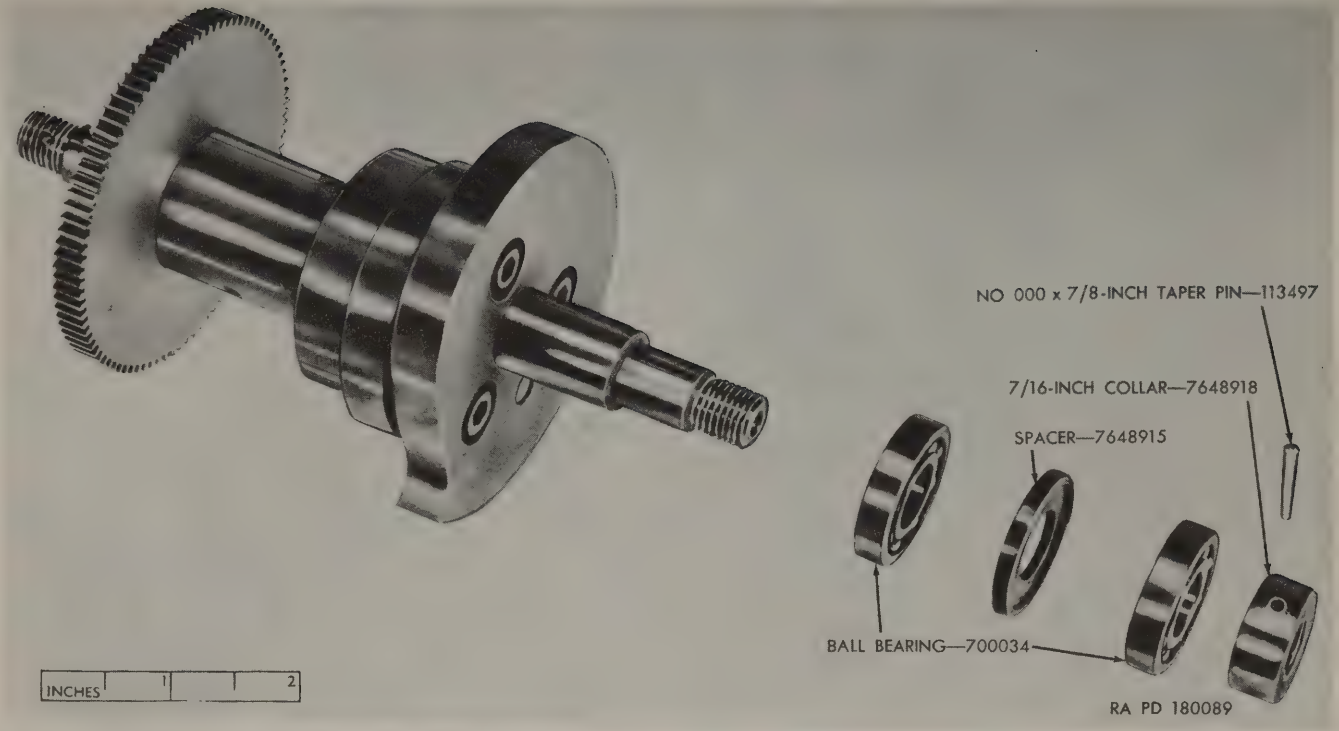



*Figure 150. Ballistic cam and related parts—partially exploded view.*

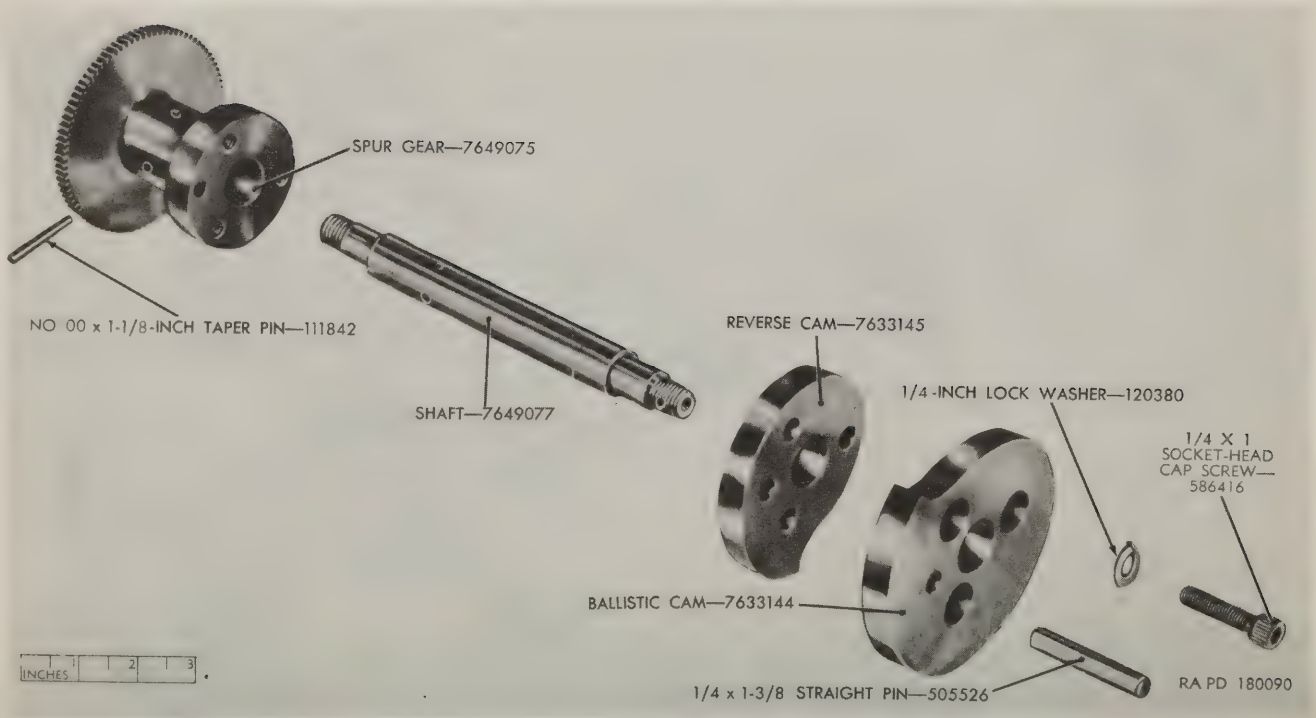



*Figure 151. Ballistic cam and related parts—partially exploded view.*

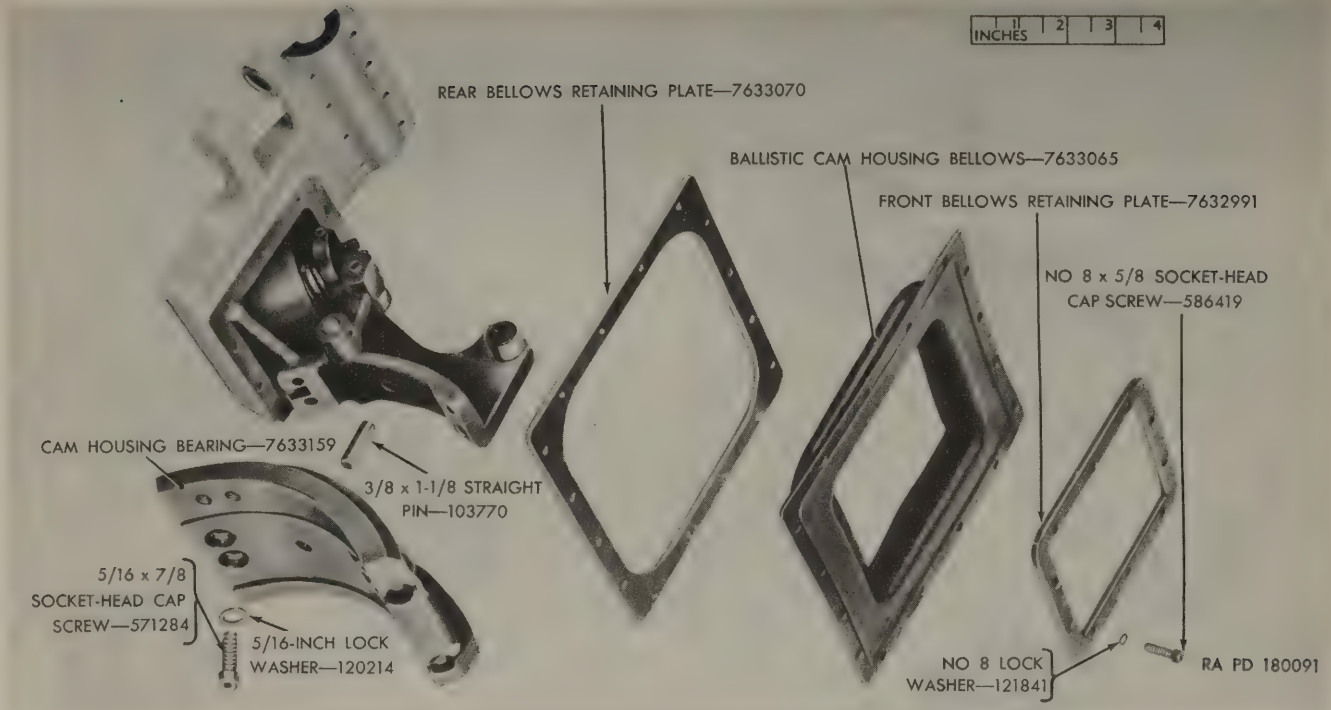

INCHES 1 2 3 4
REAR BELLOWS RETAINING PLATE—7633070
BALLISTIC CAM HOUSING BELLOWS—7633065
FRONT BELLOWS RETAINING PLATE—7632991
NO 8 x 5/8 SOCKET-HEAD CAP SCREW—586419
CAM HOUSING BEARING—7633159
3/8 x 1-1/8 STRAIGHT PIN—103770
5/16 x 7/8 SOCKET-HEAD CAP SCREW—571284
5/16-INCH LOCK WASHER—120214
NO 8 LOCK WASHER—121841
RA PD 180091

*Figure 152. Cam housing support and related parts—partially exploded view.*

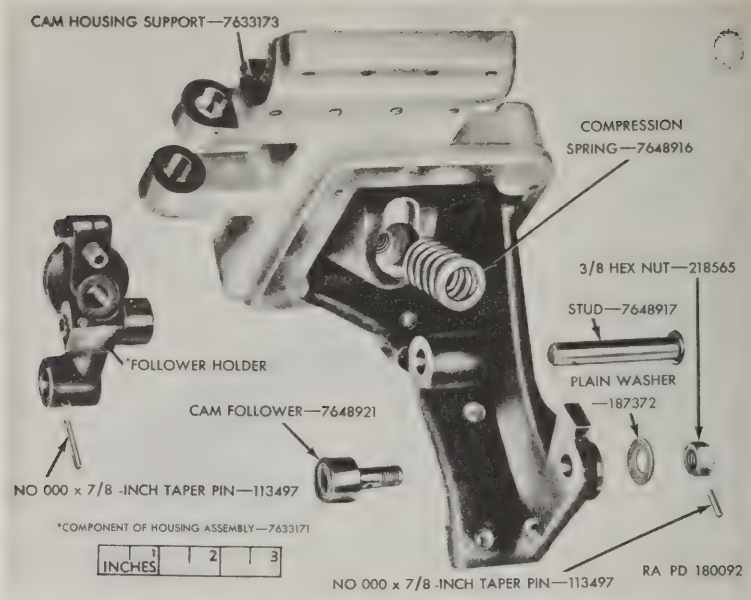



*Figure 153. Cam housing support and related parts—partially exploded view.*

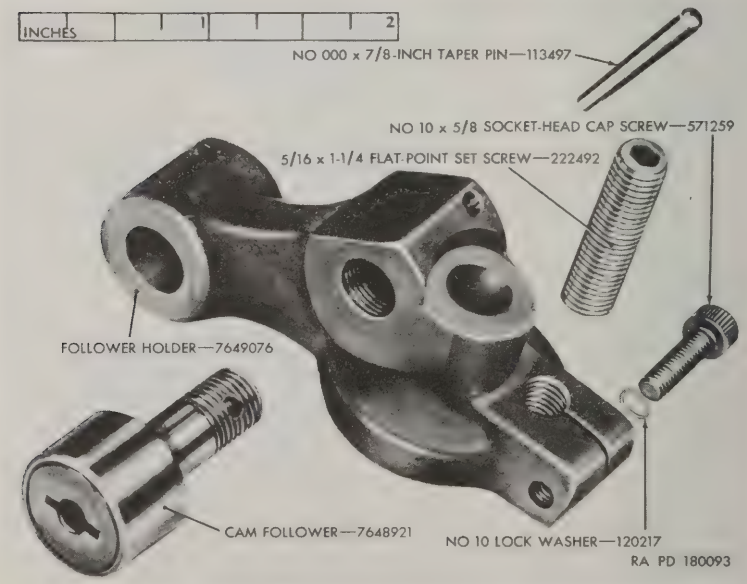

INCHES 1 2
NO 000 x 7/8-INCH TAPER PIN—113497
NO 10 x 5/8 SOCKET-HEAD CAP SCREW—571259
5/16 x 1-1/4 FLAT-POINT SET SCREW—222492
FOLLOWER HOLDER—7649076
CAM FOLLOWER—7648921
NO 10 LOCK WASHER—120217
RA PD 180093

*Figure 154. Cam follower and related parts—exploded view.*

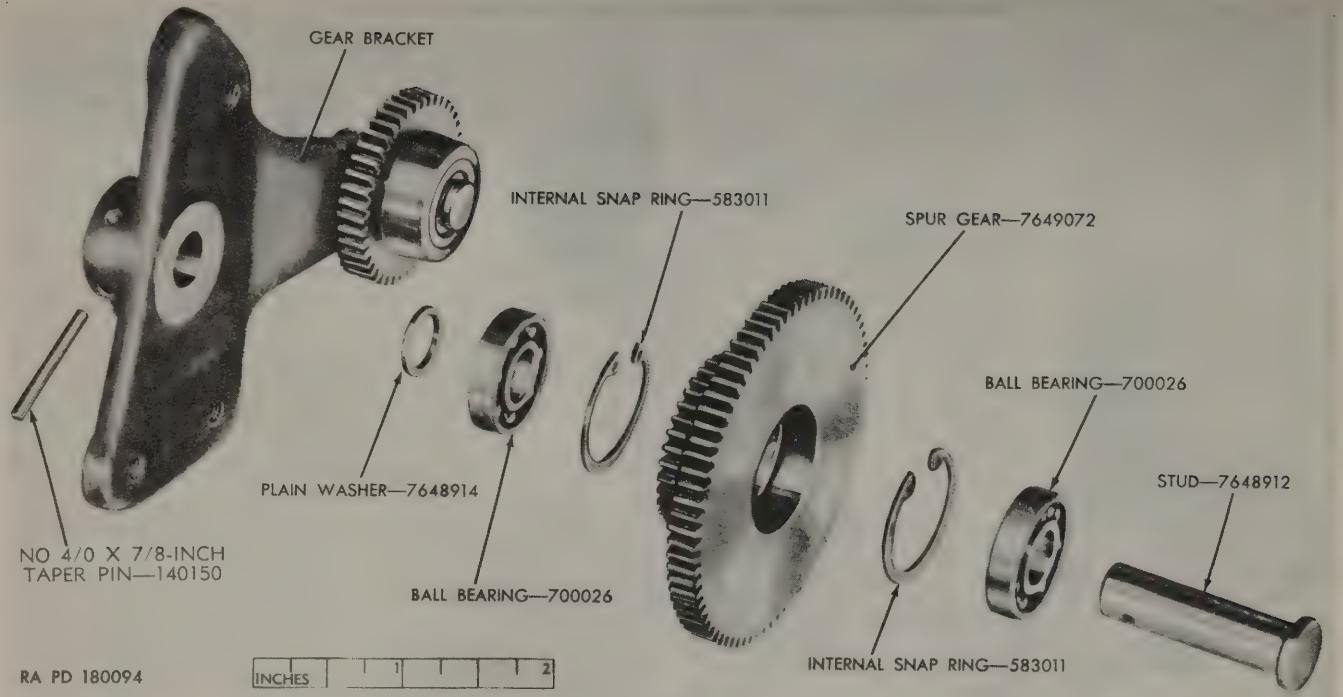



***Figure 155. Cam drive bracket assembly—partially exploded view.***

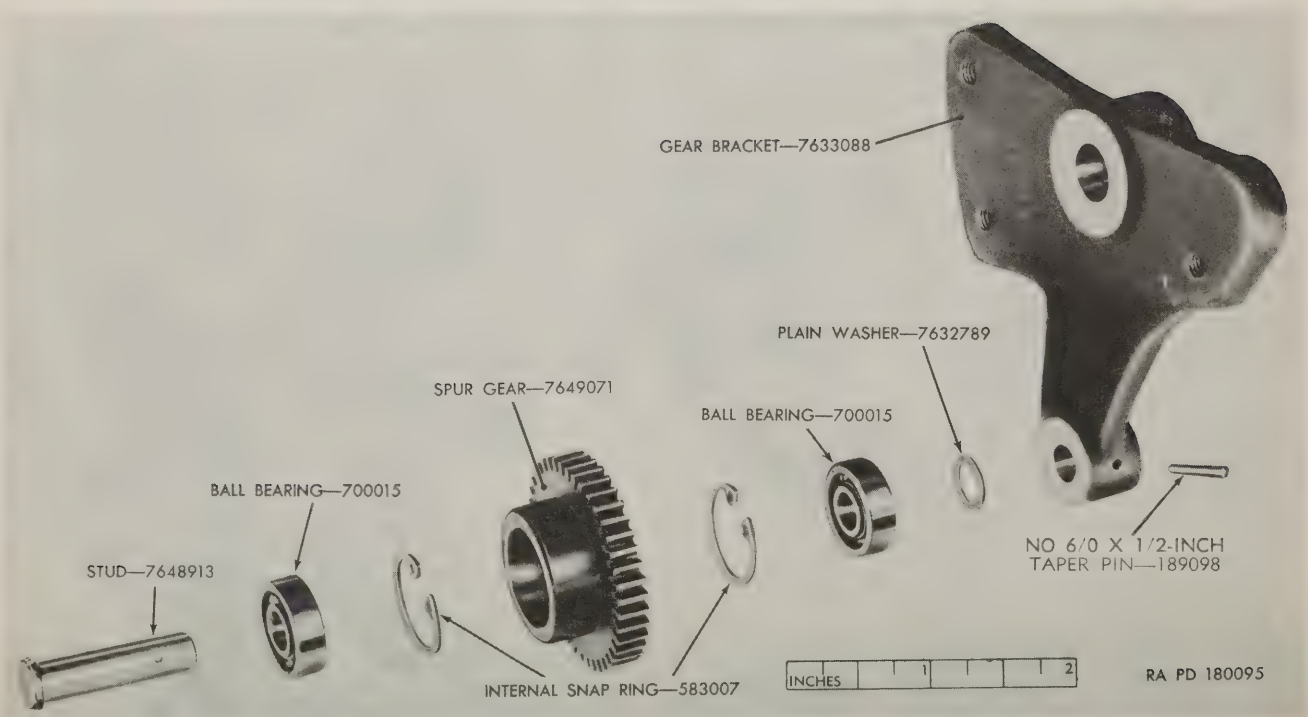



*Figure 156. Cam drive bracket assembly—partially exploded view.*

## Section VI. DISASSEMBLY OF BALLISTIC CAM HOUSING ASSEMBLY (M12)

### 161. Removal of Ballistic Cam Housing Support Caps and Superelevation Assembly

*a.* Removal of the support caps is the same as described in paragraph 153 (fig. 157).

*b.* Unscrew five fillister-head screws, punch the two straight pins from the superelevation assembly and the ballistic cam housing, and lift the superelevation assembly from the cam housing.

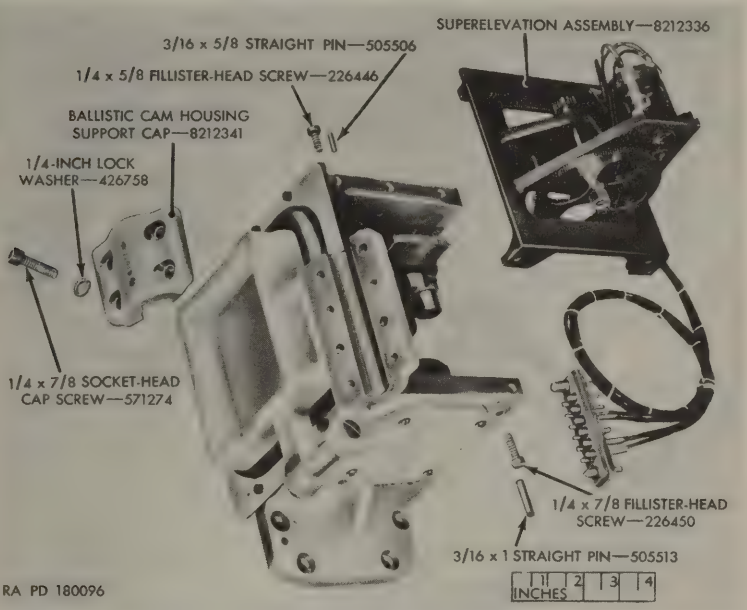

SUPERELEVATION ASSEMBLY—8212336
3/16 x 5/8 STRAIGHT PIN—505506
1/4 x 5/8 FILLISTER-HEAD SCREW—226446
BALLISTIC CAM HOUSING SUPPORT CAP—8212341
1/4-INCH LOCK WASHER—426758
1/4 x 7/8 SOCKET-HEAD CAP SCREW—571274
1/4 x 7/8 FILLISTER-HEAD SCREW—226450
3/16 x 1 STRAIGHT PIN—505513
INCHES 1 2 3 4
RA PD 180096

*Figure 157. Removal of ballistic cam housing support caps and superelevation assembly (M12 shown).*

### 162. Removal of Ballistic Cam Housing Cover, Ballistic Cam, and Related Parts (M12 Shown)

Procedure is the same as T41, paragraph 154 (fig. 158).

### 163. Removal of Level Vial Tube

Procedure is the same as T41, paragraph 155 (fig. 159).

### 164. Removal of Follower Holder, Related Parts, and Compression Spring

*a.* Procedure is the same as T41, paragraph 159*d* (fig. 160).

*b.* Lift the compression spring from the support recess.

## 165. Removal of Cam Housing Bearing, Segment Gear Assembly, Ballistic Cam Housing Bellows, and Related Parts

Procedure is the same as T41, paragraph 156 (figs. 161 and 162).

*Note.*—The parts are similar except that the M12 has a segment gear.

## 166. Removal of Cam Drive Bracket Assembly

Procedure is the same as T41, paragraph 157 (fig. 148).

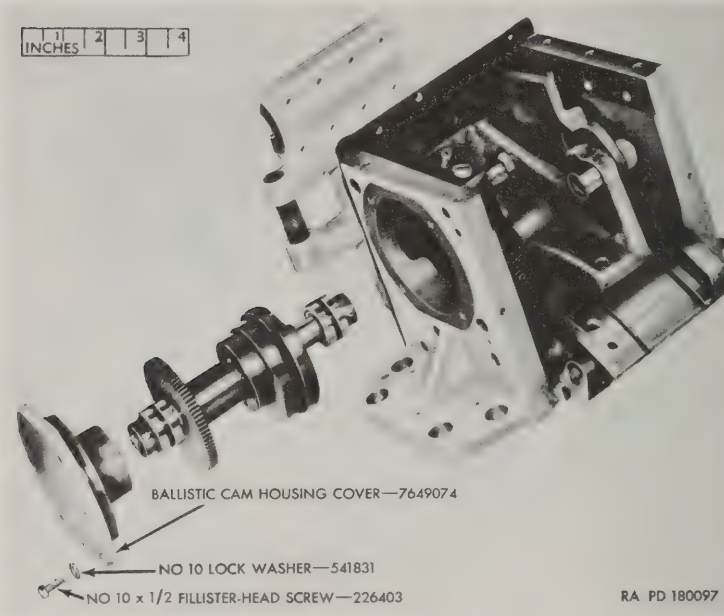

INCHES 1 2 3 4
BALLISTIC CAM HOUSING COVER—7649074
NO 10 LOCK WASHER—541831
NO 10 x 1/2 FILLISTER-HEAD SCREW—226403
RA PD 180097

*Figure 158. Removal of ballistic cam housing cover, ballistic cam, and related parts (M12 shown).*

## 167. Disassembly of Superelevation Assembly

*a.* Unscrew the three screws (fig. 163), and lock washers and remove the three mounting clamps that hold the synchro transmitter to the bracket.

*b.* Unscrew the slotted nut and slide the spur gear, with the transmitter washer attached, and the spacer from the transmitter. Pull the transmitter from the bracket.

*c.* Remove the fillister-head screw and lock washer that secures the closed clip and the harness assembly to the bracket. Pull the harness assembly from the bracket.

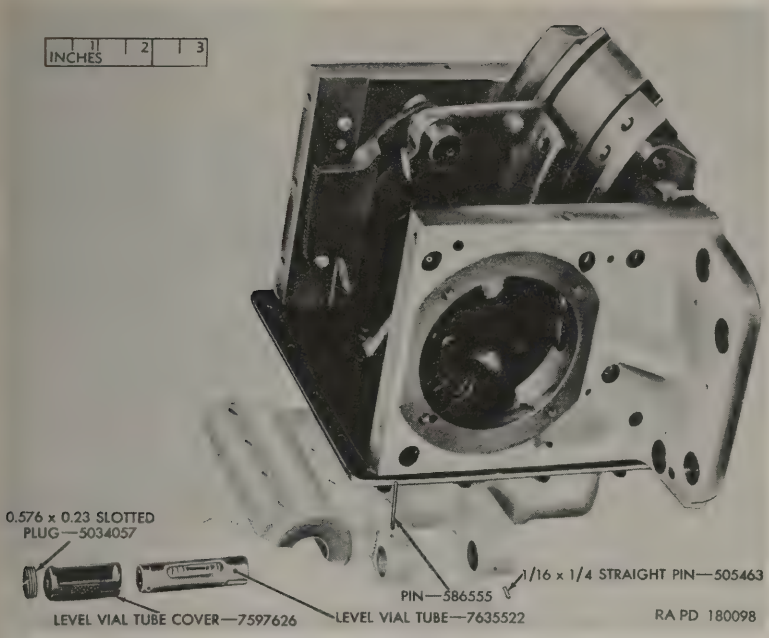



*Figure 159. Removal of level vial tube (M12 shown).*

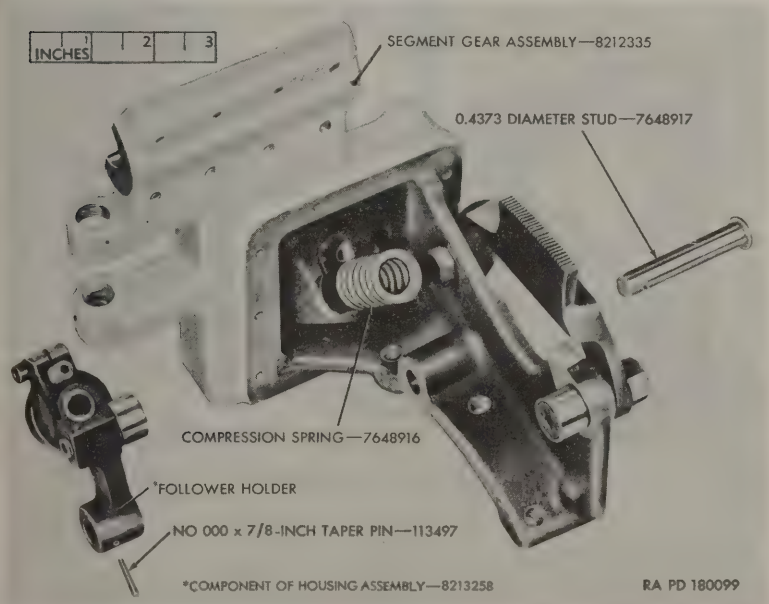



*Figure 160. Removal of follower holder, related parts, and compression spring (M12 shown).*

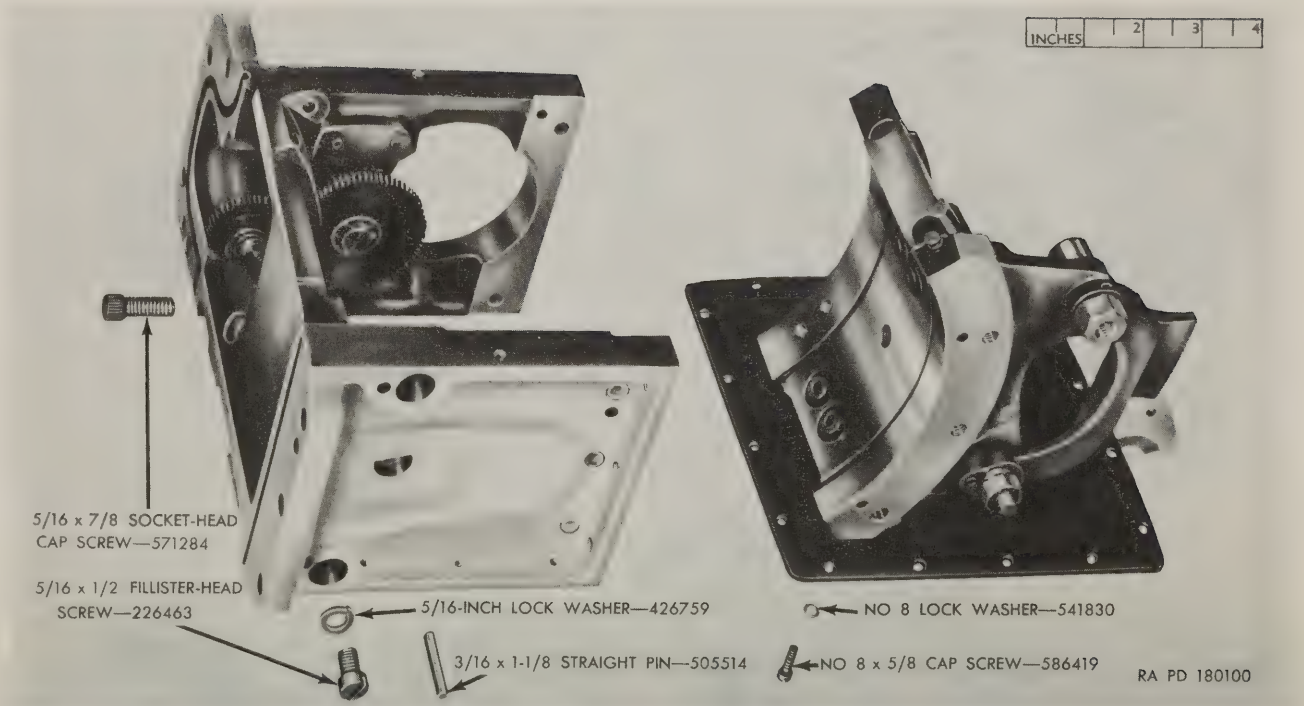



*Figure 161.—Removal of segment gear assembly with related parts.*

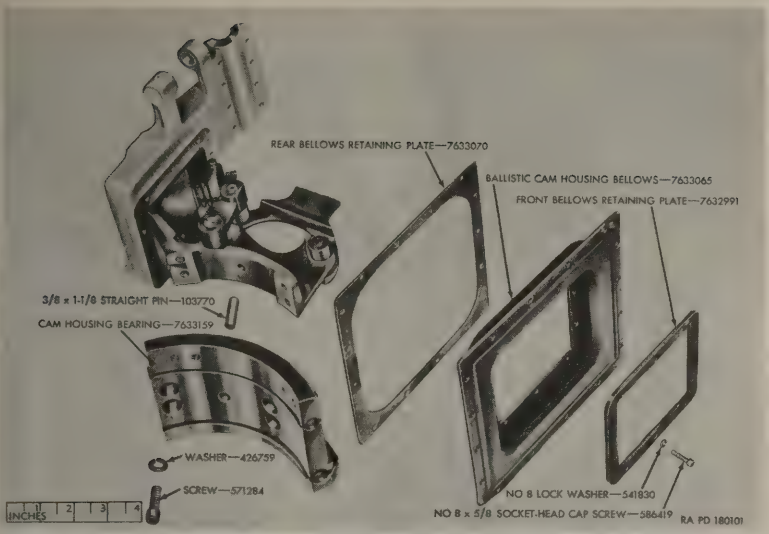



*Figure 162. Removal of cam housing bearing, ballistic cam housing bellows, and related parts.*

*d.* Heat and melt the solder that holds the harness assembly to the clips of the transmitter and pull the harness asembly from the transmitter.

*e.* Drive the two taper pins (fig. 164) from the two spur gears (par. 59*a*), pull both gears from the shaft, and withdraw the shaft from the bracket.

*f.* Tap the two ball bearings from the bracket, compress the two retaining snap rings using snap ring pliers, and lift the rings from the bracket.

## 168. Disassembly of Ballistic Cam and Related Parts

Procedure is the same as T41, paragraph 158 (figs. 149, 150, and 151).

## 169. Disassembly of Follower Holder and Related Parts

Procedure is the same as for T41, paragraph 159*f* and *g* (fig. 154).

## 170. Disassembly of Cam Drive Bracket Assembly

Procedure is the same as for T41, paragraph 160 (figs. 155 and 156).

## 171. Disassembly of Segment Gear Assembly

*a.* Drive the taper pin (fig. 165) from the hex nut and the cam follower (par. 59*a*), unscrew the nut, and withdraw the follower from the segment gear and the support.

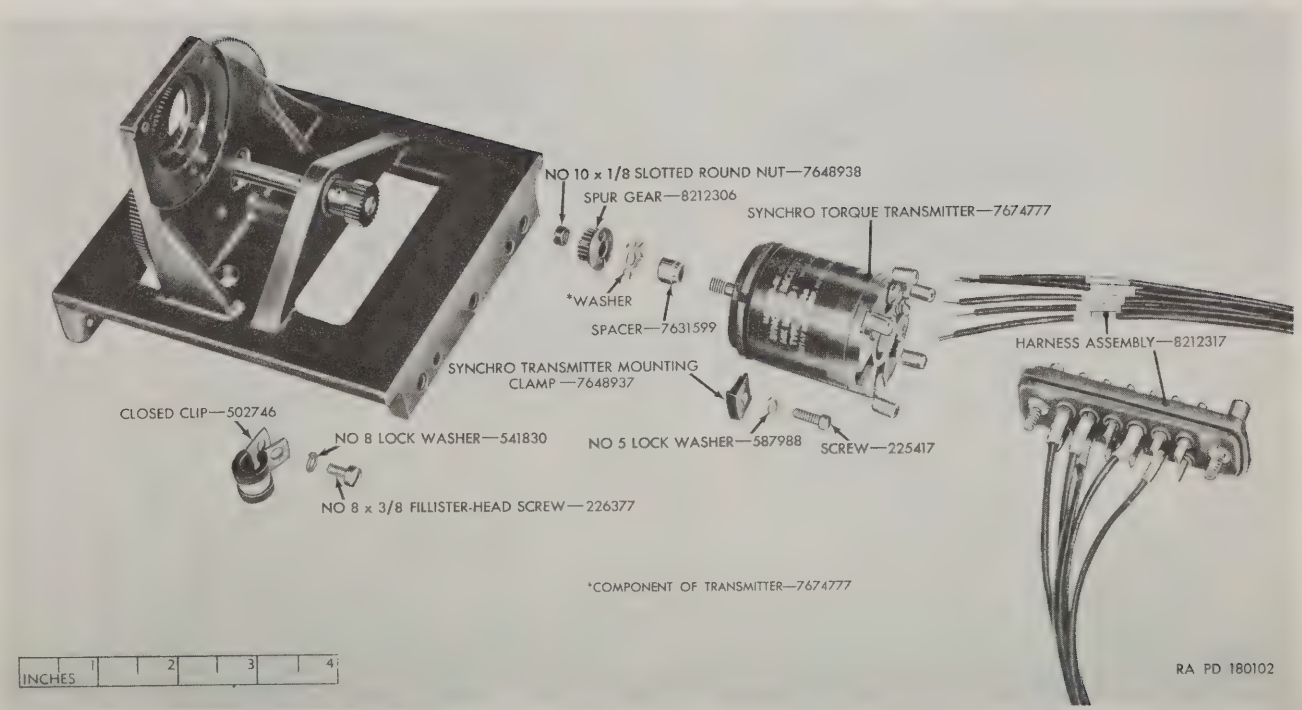



*Figure 163. Superelevation assembly—partially exploded view.*

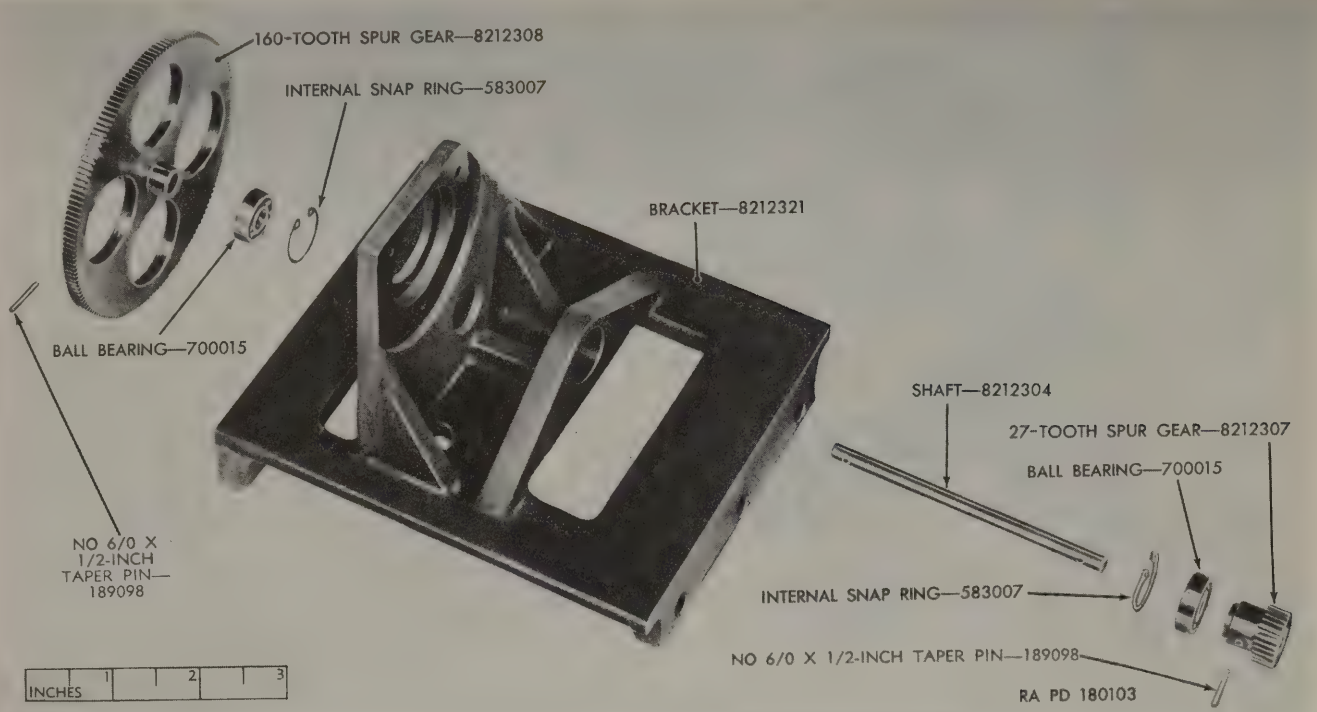



*Figure 164. Superelevation assembly—partially exploded view.*

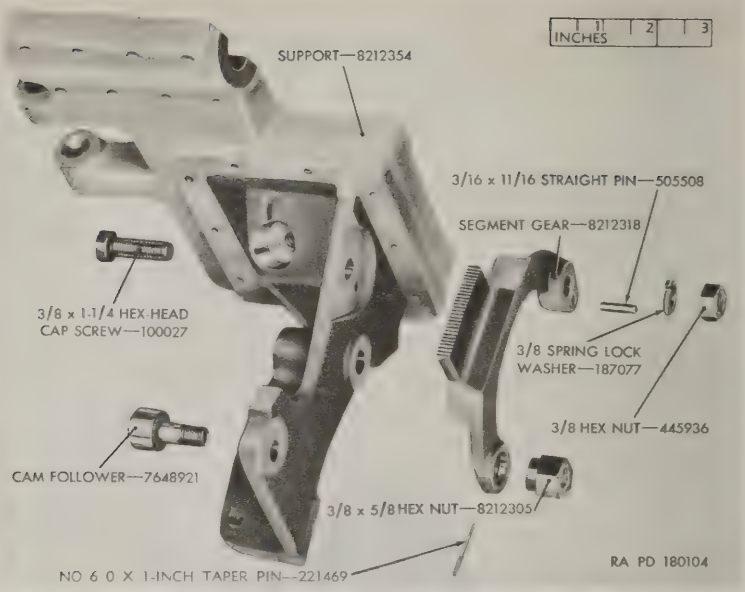



*Figure 165. Segment gear assembly—exploded view.*

*b.* Unscrew the hex nut from the cap screw, remove the lock washer, withdraw the screw from the support and the gear, and pull the segment gear from the support.

*c.* Drive the straight pin from the support.

## Section VII. DISASSEMBLY OF COLLIMATOR ASSEMBLY

### 172. Removal of Ammunition, Bore Sight and Range Scale Assembly, Constant Rise Cam Assembly, and Flexible Shafts

*a.* Unhook the extension spring (fig. 166) from the clevis of the scale assembly and the arm of the mirror assembly.

*b.* Unscrew the four fillister-head screws and lock washers that secure the scale assembly to the collimator housing and pull the scale assembly from the collimator housing.

*c.* Unscrew the clevis from the scale assembly.

*d.* Drive the taper pins from the couplings of the two flexible shafts (par. 59*a*) and pull the flexible shafts from the scale assembly.

*e.* Unscrew the two fillister-head screws and lock washers that secure the cam assembly to the scale assembly, pull the cam assembly from the scale assembly and pull the two straight pins from the scale assembly.

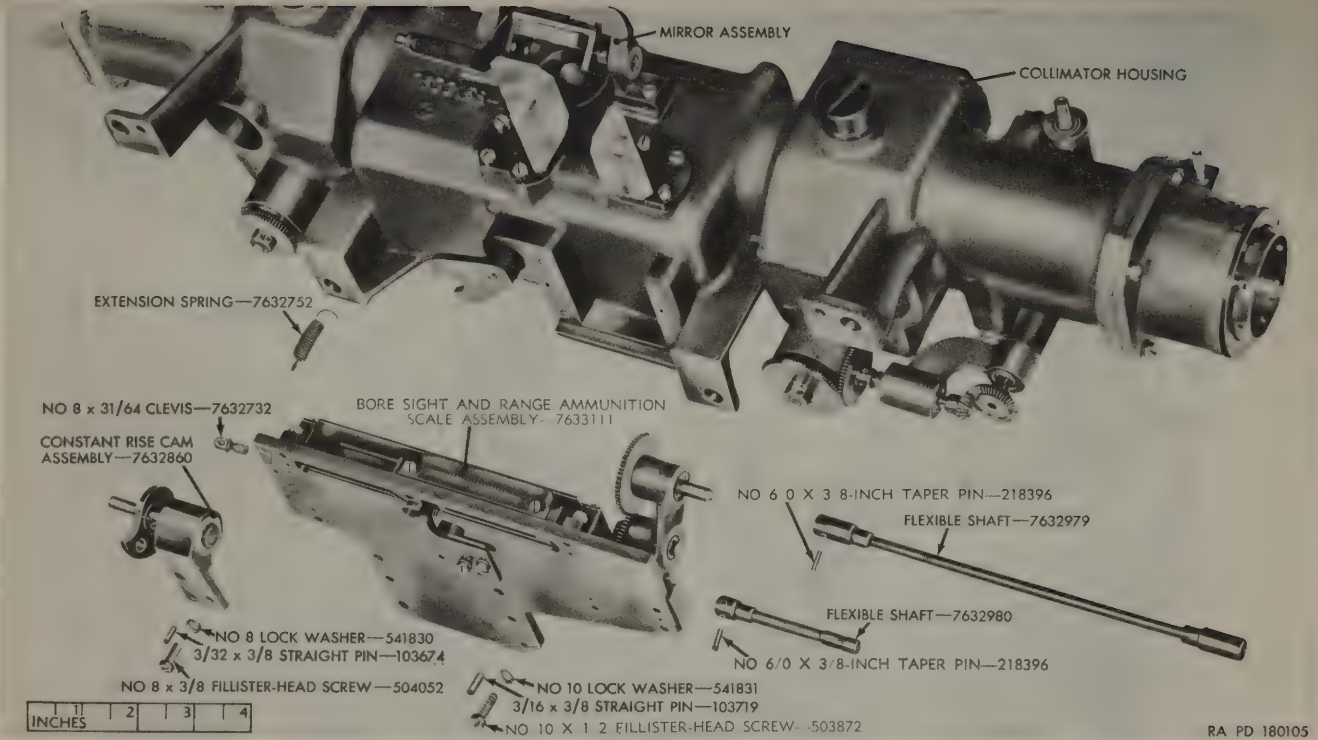



*Figure 166. Removal of ammunition, bore sight and range scale assembly, constant rise cam assembly, and flexible shafts.*

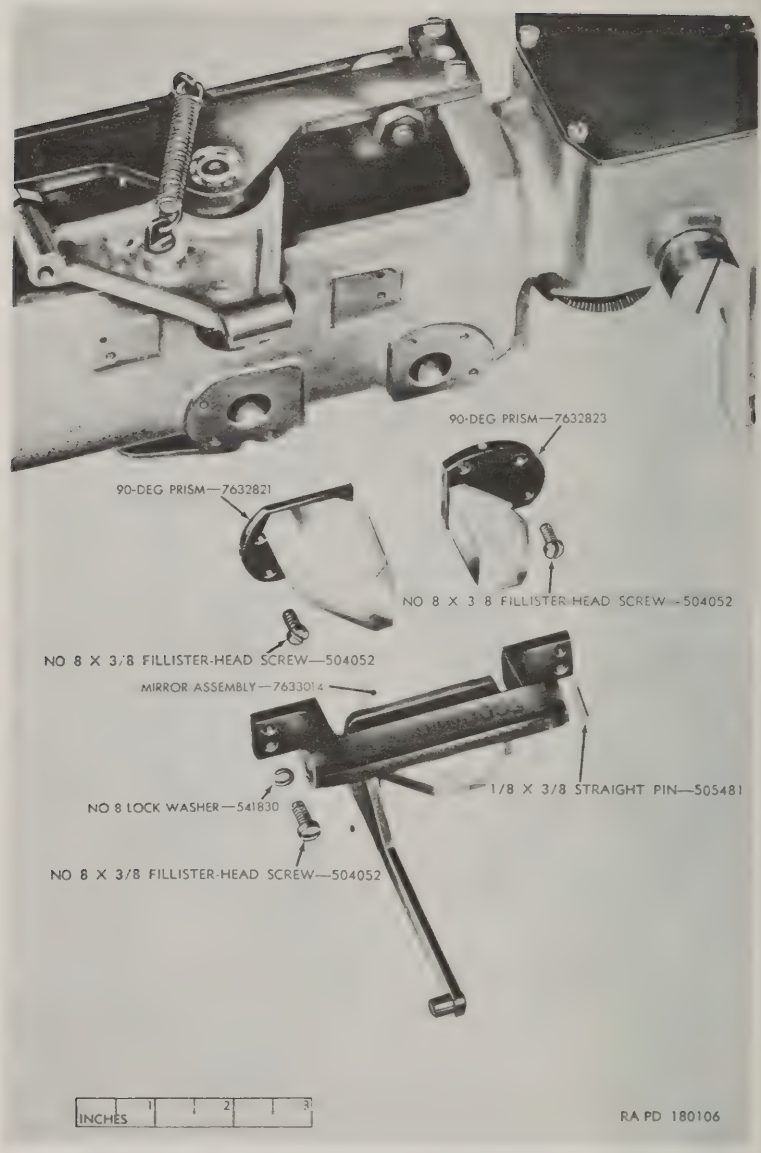



*Figure 167. Removal of mirror assembly and 90° prisms.*

## 173. Removal of Mirror Assembly and 90° Prisms

*a.* Unscrew the two fillister-head screws (fig. 167) and lock washers that secure the mirror assembly to the mounting surface of the collimator housing. Pull the mirror assembly from the collimator housing and pull the two straight pins from the housing.

*b.* Unscrew the three fillister-head screws that secure each 90° prism to the collimator housing and remove the two prisms from the housing.

## 174. Removal of Correction Wedge Housing Assembly

*a.* Unscrew the four fillister-head screws (fig. 168) and lock washers that secure the correction wedge assembly to the collimator housing and pull the assembly from the collimator housing.

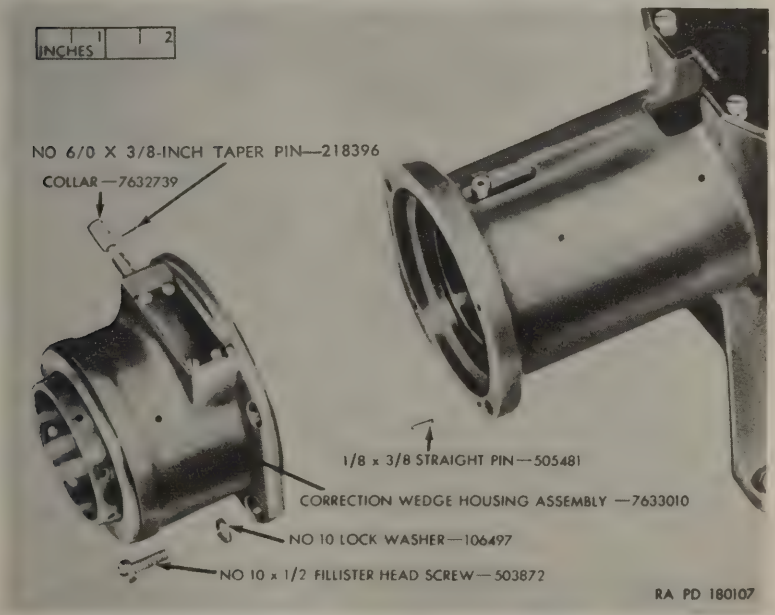

INCHES 1 2
NO 6/0 X 3/8-INCH TAPER PIN—218396
COLLAR—7632739
1/8 x 3/8 STRAIGHT PIN—505481
CORRECTION WEDGE HOUSING ASSEMBLY —7633010
NO 10 LOCK WASHER—106497
NO 10 x 1/2 FILLISTER HEAD SCREW—503872
RA PD 180107

***Figure 168. Removal of correction wedge housing assembly.***

*b.* Pull the straight pin from the collimator housing, remove the taper pin from the collar (par. 56), and pull the collar from the housing assembly.

## 175. Removal of Reticle Cover and Beam-Splitter Rotating Bracket Assembly

*a.* Unscrew the four fillister-head screws (fig. 169) that secure the reticle cover to the collimator housing and lift the reticle cover from the collimator housing.

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*b.* Unscrew the two fillister-head screws and lock washers that secure the beam-splitter rotating bracket assembly to the collimator housing and lift the bracket assembly from the housing.

*c.* Pull the two straight pins from the collimator housing.

## 176. Removal of Horizontal Reticle Drive Bracket Assembly

Unscrew the two fillister-head screws (fig. 170) and lock washers that secure the horizontal reticle drive bracket assembly to the collimator housing. Pull the bracket assembly and the two straight pins from the housing.

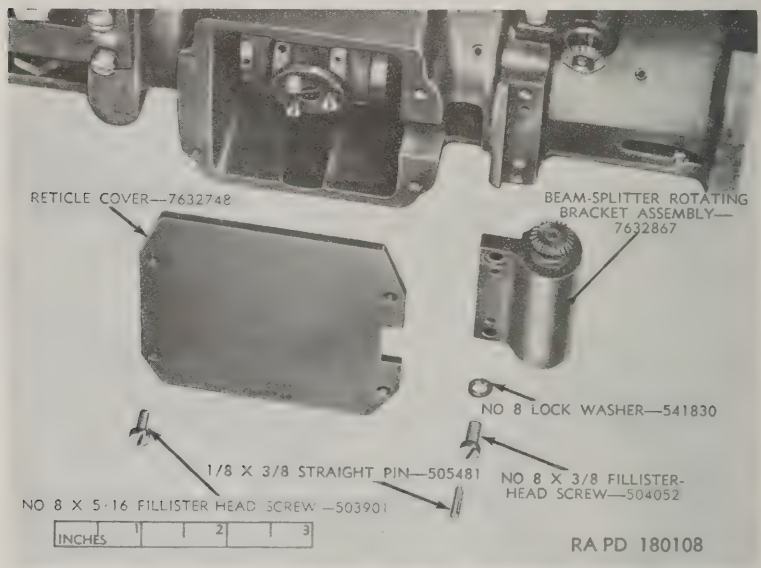
RETICLE COVER—7632748
BEAM-SPLITTER ROTATING BRACKET ASSEMBLY—7632867
NO 8 LOCK WASHER—541830
1/8 X 3/8 STRAIGHT PIN—505481
NO 8 X 3/8 FILLISTER-HEAD SCREW—504052
NO 8 X 5/16 FILLISTER HEAD SCREW—503901
INCHES
RA PD 180108

*Figure 169. Removal of reticle cover and beam-splitter rotating bracket assembly.*

## 177. Removal of Beam-Splitter Stop Bracket Assembly

*a.* Unhook the extension spring (fig. 171) from the beam splitter stop bracket assembly clevis and the collimator housing clevis. Unscrew the four fillister-head screws and lock washers that secure the bracket assembly to the collimator housing.

*b.* Pull the bracket and the two straight pins from the collimator housing.

## 178. Removal of Scale Transfer Prism Assembly and Related Parts

*a.* Drive the taper pin (fig. 172) from the beam-splitter actuating arm (par. 59*a*) and pull the arm from the prism assembly.

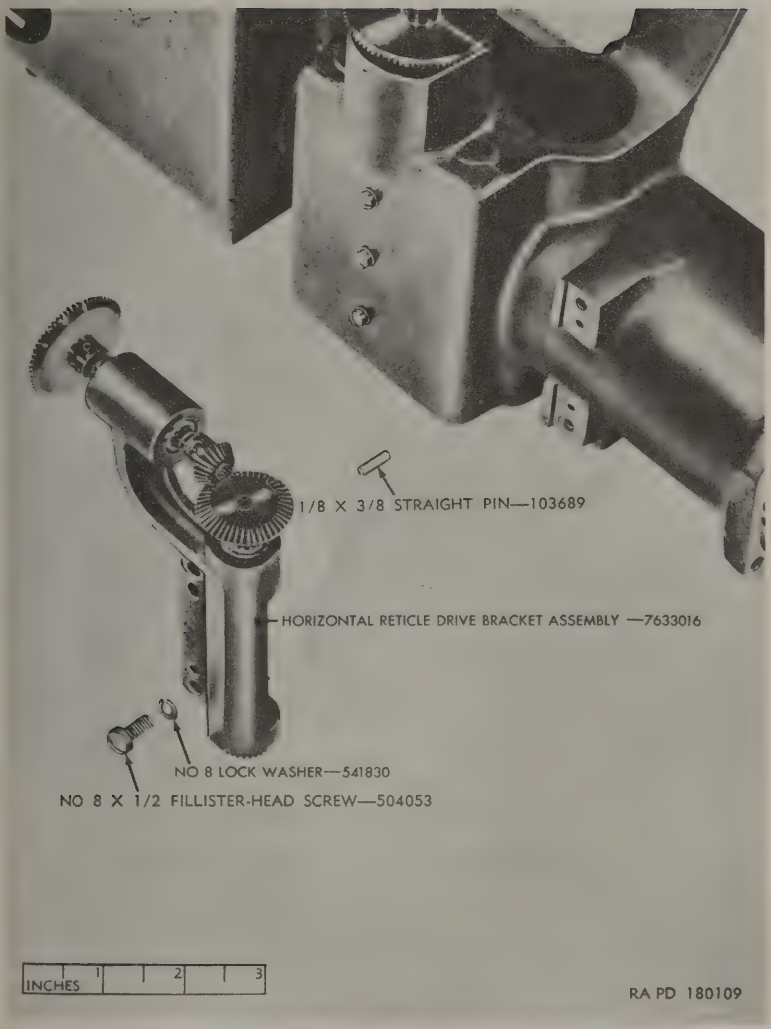


*Figure 170. Removal of horizontal reticle drive bracket assembly.*

*b.* Pull the beam-splitter prism assembly from the bearing retainer, unscrew the three fillister-head screws and lock washers that secure the retainer to the collimator housing. Lift the retainer from the housing.

*c.* Tap the ball bearing from the retainer and tap the Woodruff key from the prism assembly.

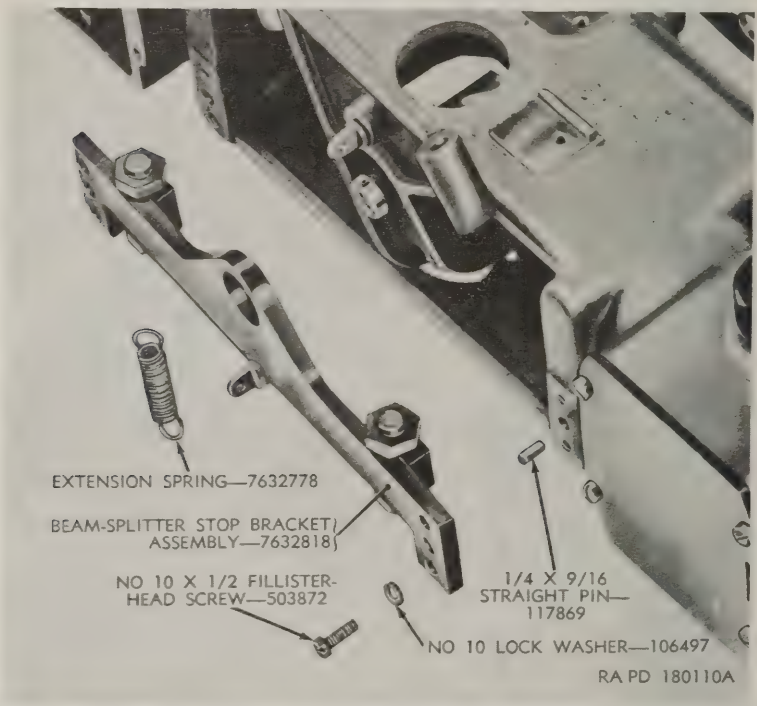
EXTENSION SPRING—7632778
BEAM-SPLITTER STOP BRACKET ASSEMBLY—7632818
NO 10 X 1/2 FILLISTER-HEAD SCREW—503872
1/4 X 9/16 STRAIGHT PIN—117869
NO 10 LOCK WASHER—106497
RA PD 180110A

*Figure 171. Removal of beam-splitter stop bracket assembly.*

## 179. Removal of Collimator Lens Alining Assembly

*a.* Unscrew the four cup-point set screws (fig. 173) from the collimator housing (par. 56). Unscrew the slotted stud from the alining assembly and remove the stud through the slot in the collimator housing.

*b.* Pull the alining housing from the collimator housing.

## 180. Removal of Plunger Assembly and Related Parts

Unscrew the slotted cap (fig. 174) from the collimator housing, pull the compression spring from the plunger assembly, and pull the plunger assembly from the collimator housing.

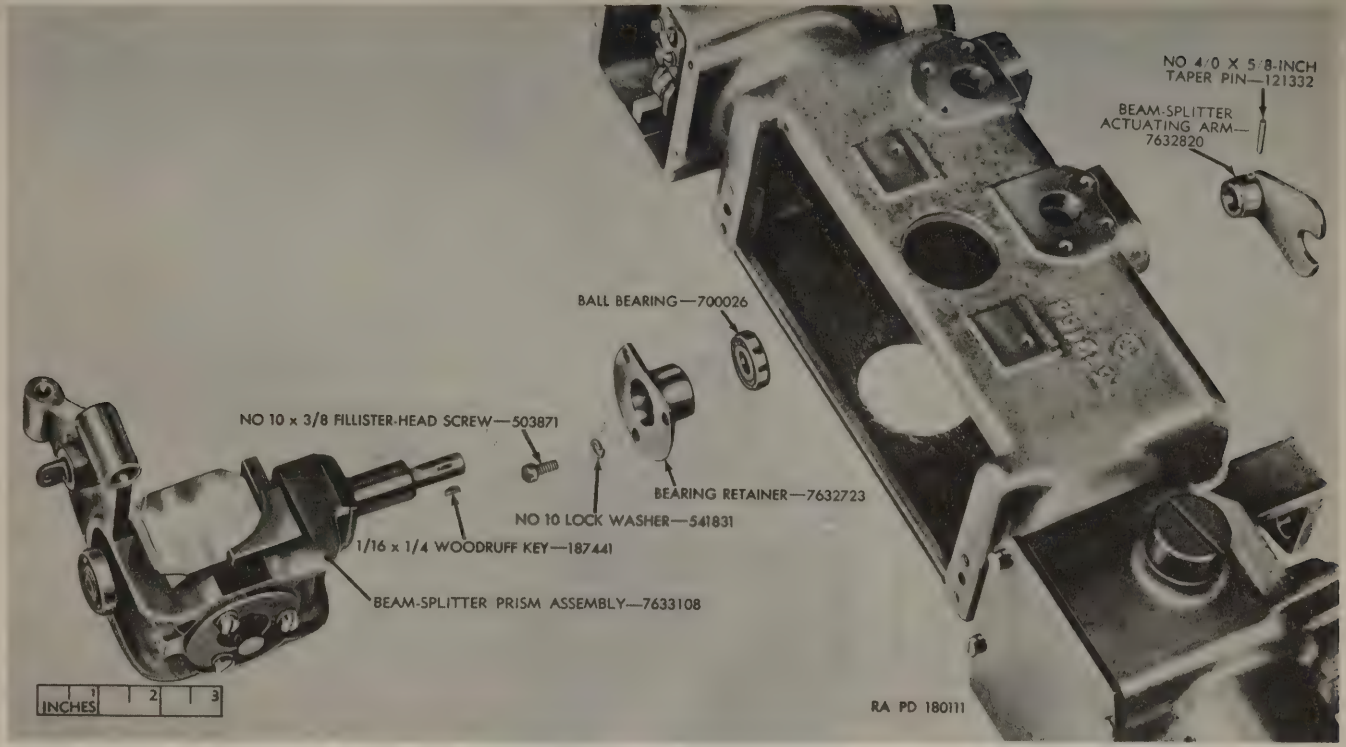


*Figure 172. Removal of scale transfer prism assembly and related parts.*

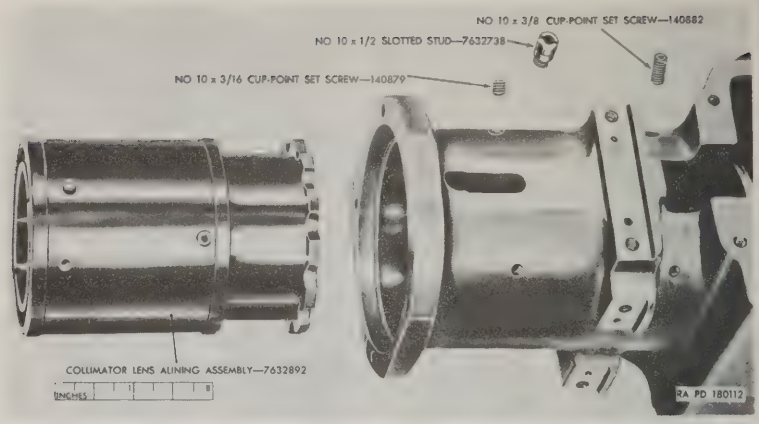
NO 10 x 3/8 CUP-POINT SET SCREW—140882
NO 10 x 1/2 SLOTTED STUD—7632738
NO 10 x 3/16 CUP-POINT SET SCREW—140879
COLLIMATOR LENS ALINING ASSEMBLY—7632892
INCHES
RA PD 180112

*Figure 173. Removal of collimator lens alining assembly.*

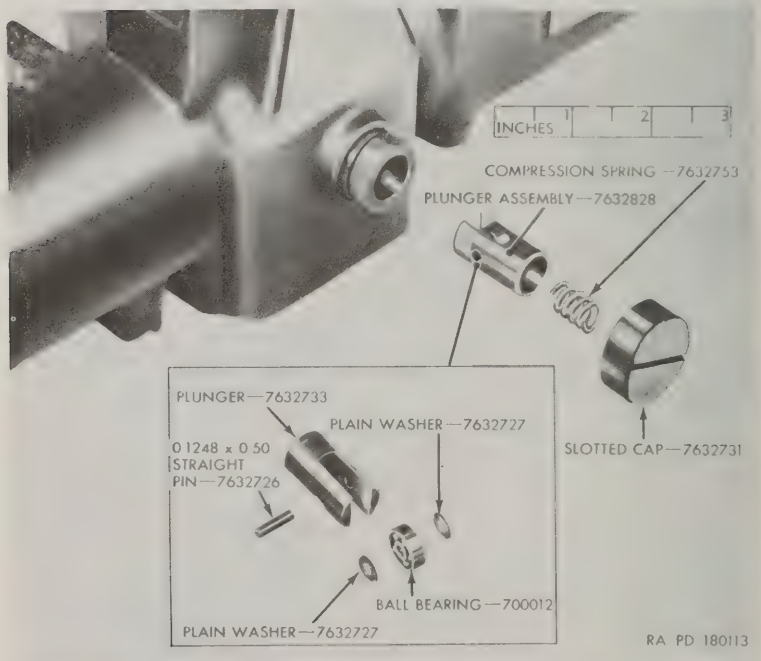


*Figure 174. Removal of plunger assembly and related parts.*

## 181. Removal of Right Reticle Drive Shaft and Related Parts

*a.* Drive the taper pin (fig. 175) from the bevel gear (par. 59*a*). Slide the gear from the drive shaft and remove the set screw from the collimator housing (par. 56).

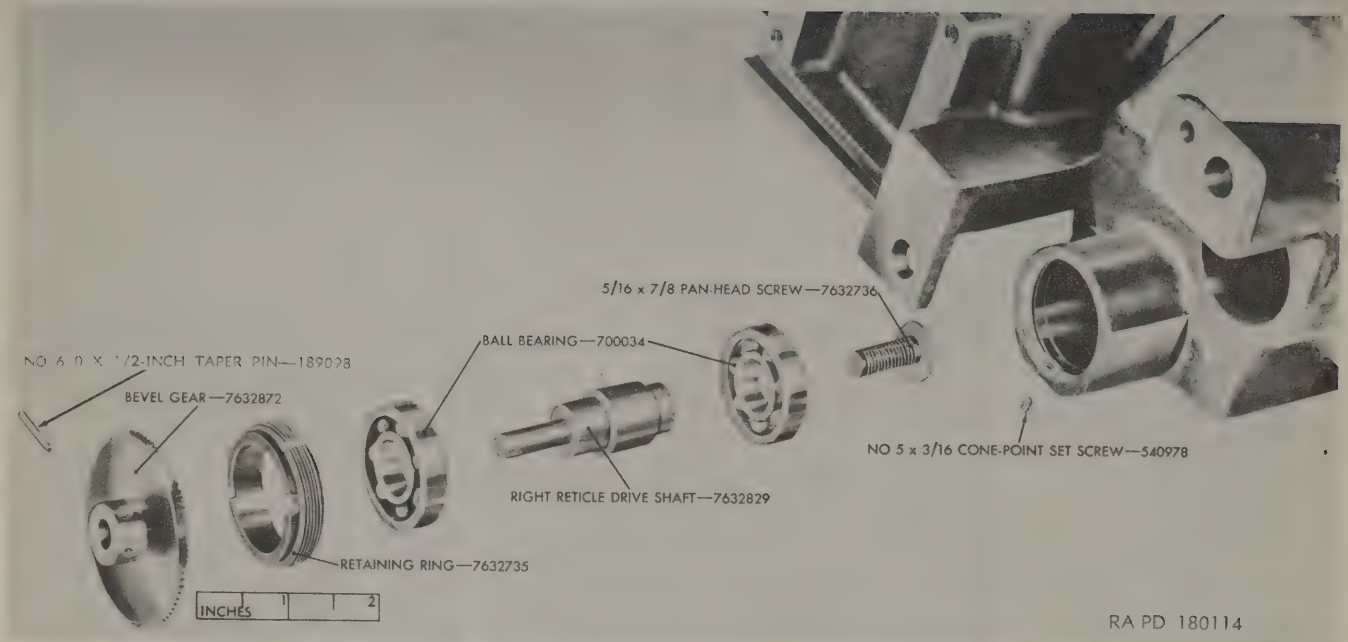


*Figure 175. Removal of right reticle drive shaft and related parts.*

*b.* Unscrew the retaining ring from the housing using an improvised 1⅛-inch tubular wrench (fig. 58). Pull the drive shaft from the housing with the two ball bearings and the pan-head screw. Slide one ball bearing from the shaft.

*c.* Unscrew the pan-head screw from the shaft and slide the other ball bearing from the shaft.

### 182. Removal of Left Reticle Drive Shaft and Related Parts

Follow the same procedure as for the right reticle drive shaft (fig. 176).

### 183. Removal of Reticle Assembly

*a.* Unhook the two extension springs (fig. 177) from the two clevises in the collimator housing and from the straight pins in the reticle assembly.

*b.* Slide the reticle assembly from the collimator housing. Unscrew the two clevises from the housing.

### 184. Removal of Rail

Unscrew the three fillister-head screws (fig. 178) and lock washers that secure the rail to the collimator housing. Pull the rail and four straight pins from the housing.

### 185. Disassembly of Constant Rise Cam Assembly

Drive the taper pin (fig. 179) from the rise cam and the shaft (par. 59*a*). Slide the cam and the bracket from the shaft and tap the ball bearings from the bracket.

### 186. Disassembly of the Ammunition, Bore Sight, and Range Scale Assembly

*a.* Remove the range and sighting reticle drive bracket assembly and scale rack as described in (1) and (2) below.

(1) Unscrew the two fillister-head screws (fig. 180) and lock washers that secure the bracket assembly to the base. Pull the bracket assembly and two straight pins from the base.

(2) Unscrew the two fillister-head screws that secure the scale rack to the ammo scale. Pull the two straight pins from the ammo scale.

*b.* To disassemble the range and sighting reticle drive bracket assembly, drive a taper pin (fig. 181) from each spur gear (par. 59*a*) and slide both the gears from the shafts. Withdraw both the shafts from the bracket and tap the four ball bearings from the bracket.

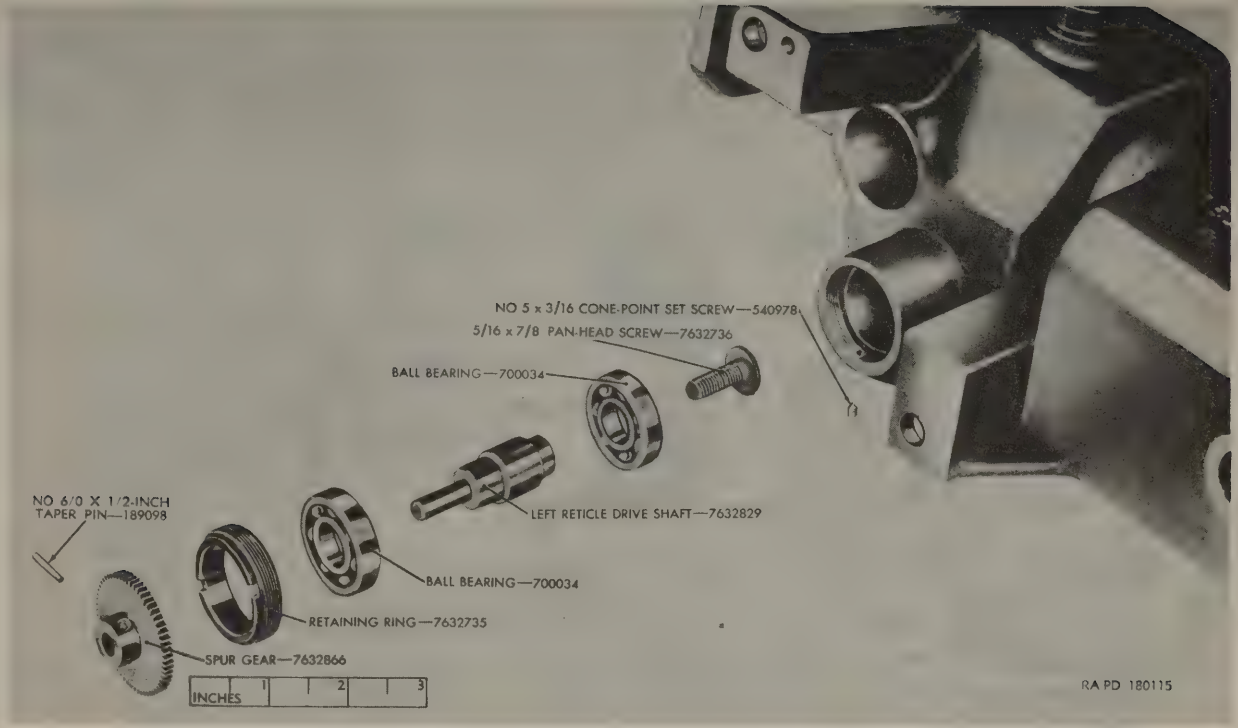


*Figure 176. Removal of left reticle drive shaft and related parts.*

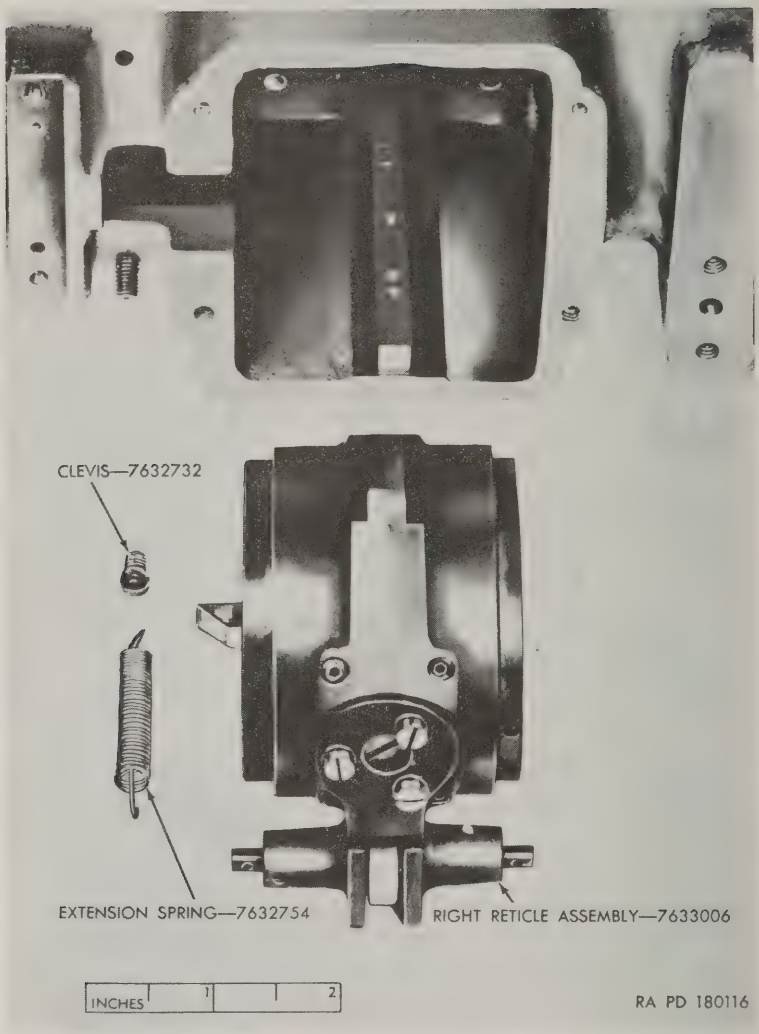


*Figure 177. Removal of reticle assembly.*

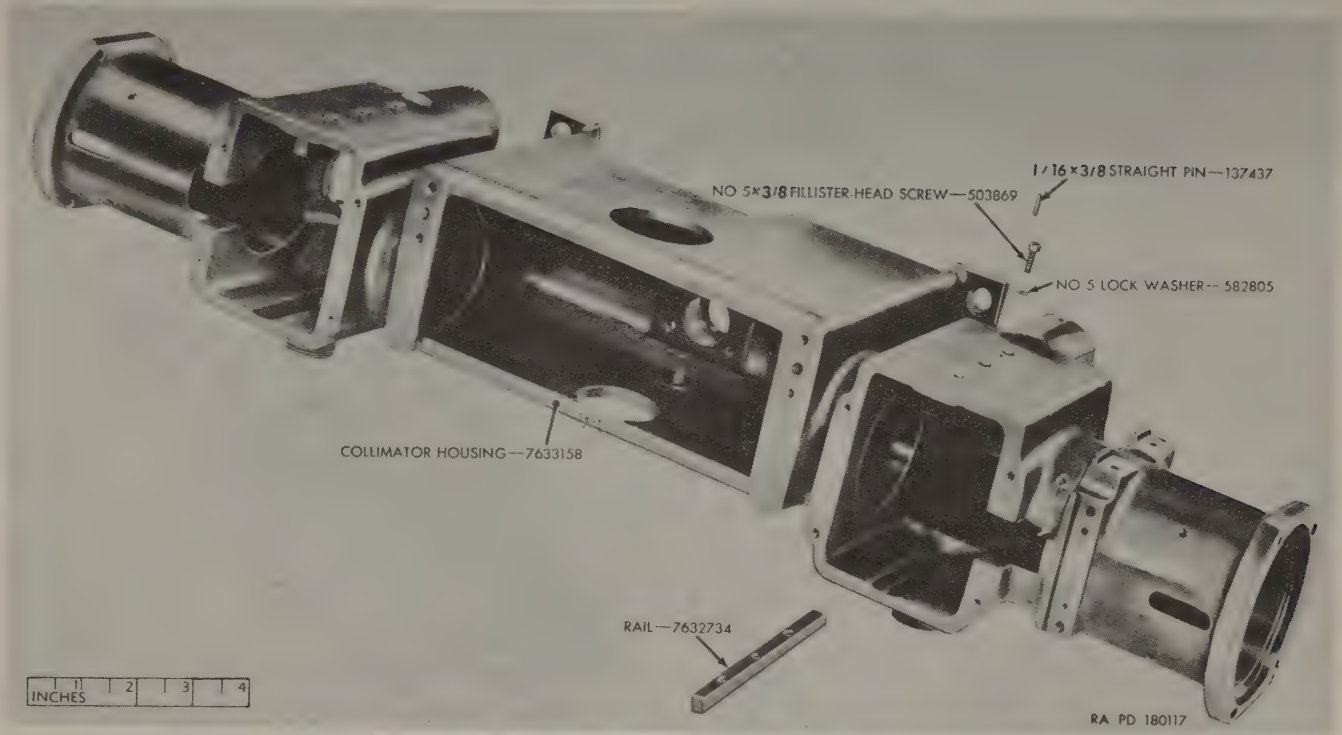


*Figure 178. Removal of rail.*

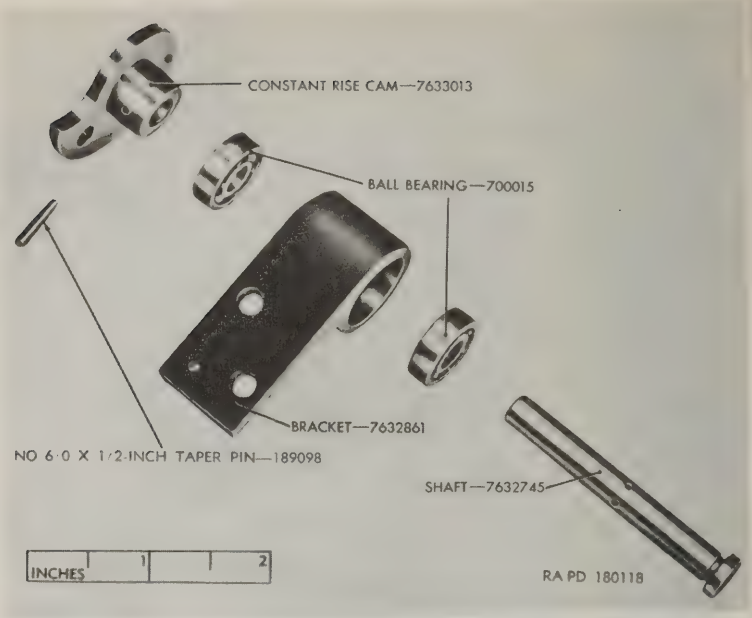


*Figure 179. Constant rise cam assembly—exploded view.*

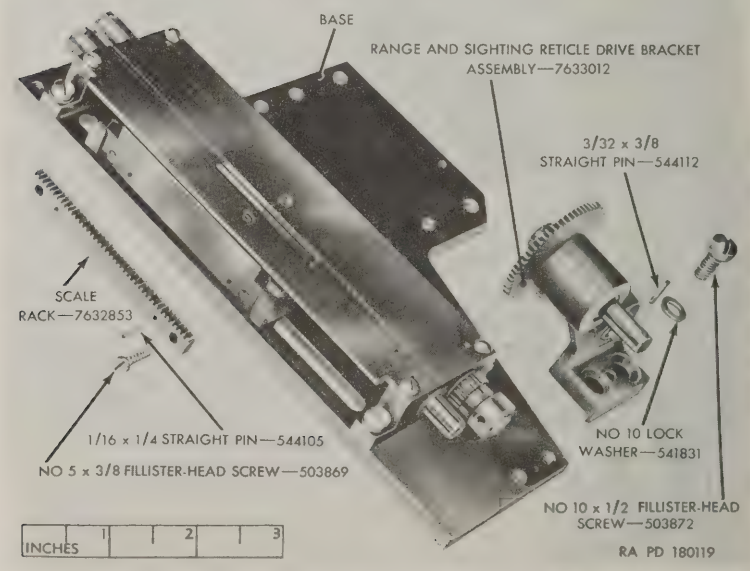
BASE
RANGE AND SIGHTING RETICLE DRIVE BRACKET ASSEMBLY—7633012
3/32 x 3/8 STRAIGHT PIN—544112
SCALE RACK—7632853
1/16 x 1/4 STRAIGHT PIN—544105
NO 5 x 3/8 FILLISTER-HEAD SCREW—503869
NO 10 LOCK WASHER—541831
NO 10 x 1/2 FILLISTER-HEAD SCREW—503872
INCHES 1 2 3
RA PD 180119

*Figure 180. Removal of the range and sighting reticle drive bracket assembly and scale rack.*

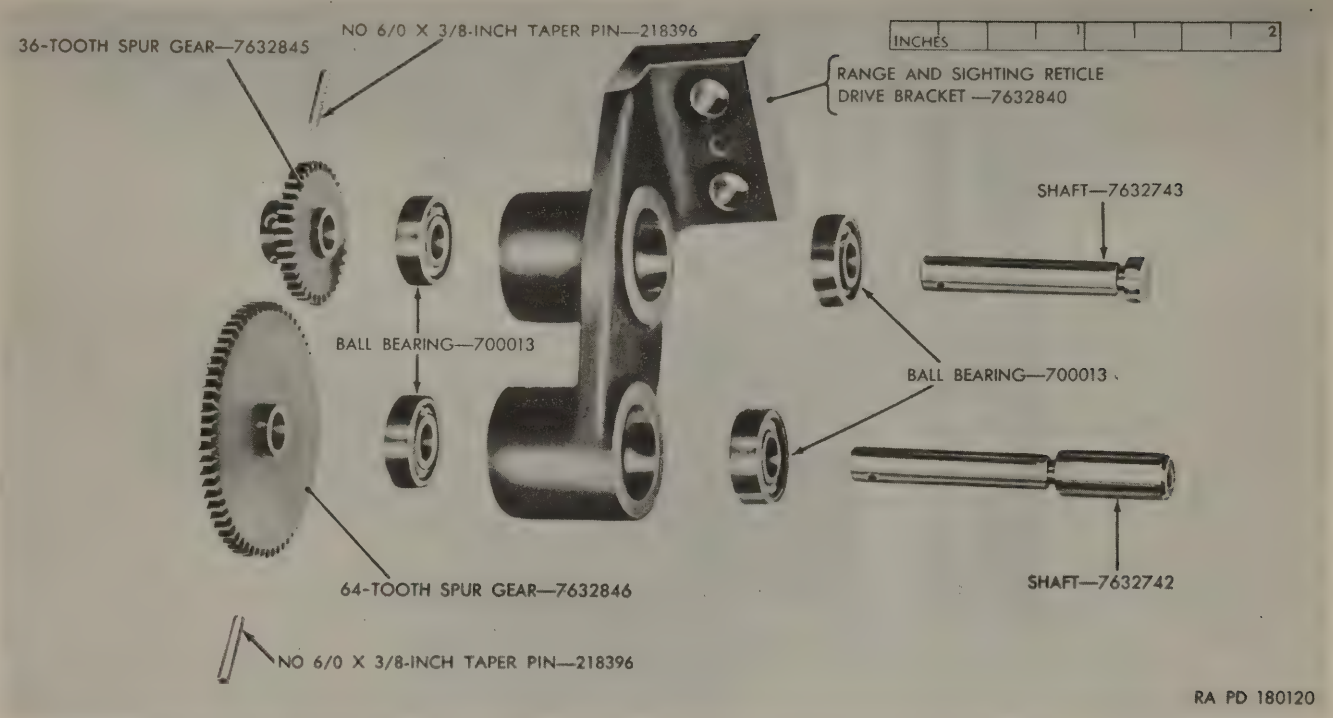


*Figure 181. Range and sighting reticle drive bracket assembly—exploded view.*

*c.* Unscrew the four round-head screws (fig. 182) that secure the range scale and ammo indexes to the sighting reticle brackets. Lift the two indexes from the brackets and pull the two straight pins from each bracket. Punch out one index 7632809 from the range scale and one from the ammo index.

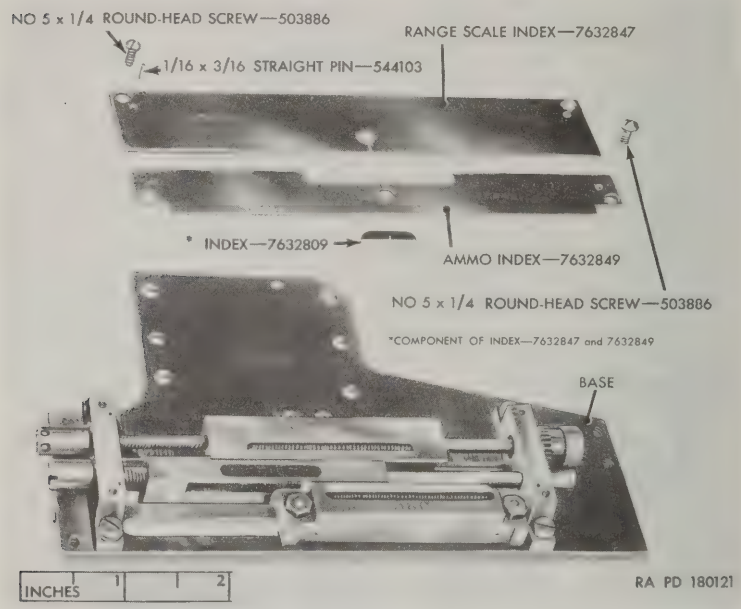


*Figure 182. Removal of indexes.*

*d.* Unscrew the two fillister-head screws (fig. 183) and two lock washers that secure the range scale guide to the base. Lift the guide and pull the two straight pins from the base.

*e.* Remove one set screw from the lead-screw nut (par. 56) and one from the lead-screw collar. Unscrew the collar and the nut from the lead screws.

*f.* Unscrew a flat-head screw (fig. 184) and a flat-point set screw from the range scale (par. 56). Unscrew the lead screw from the range scale and when the screw just disengages the scale, scribe lines on the scale and the lead screw (par. 55*d*) to identify the proper thread for reassembly. Slide the lead screw from the left sighting reticle bracket. With a knife, pry off reticle 7633002 and scale 7633104 from the sighting reticle and the range scale.

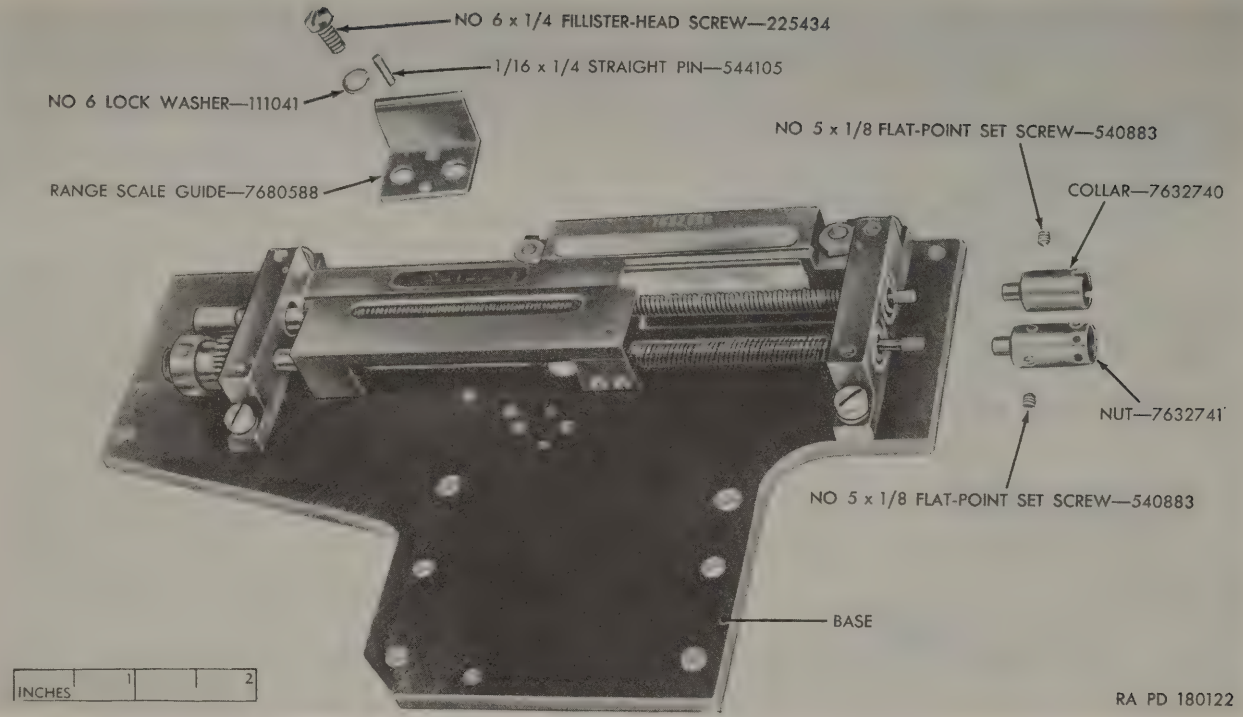


*Figure 183. Removal of range scale guide, lead screw, nut and collar.*

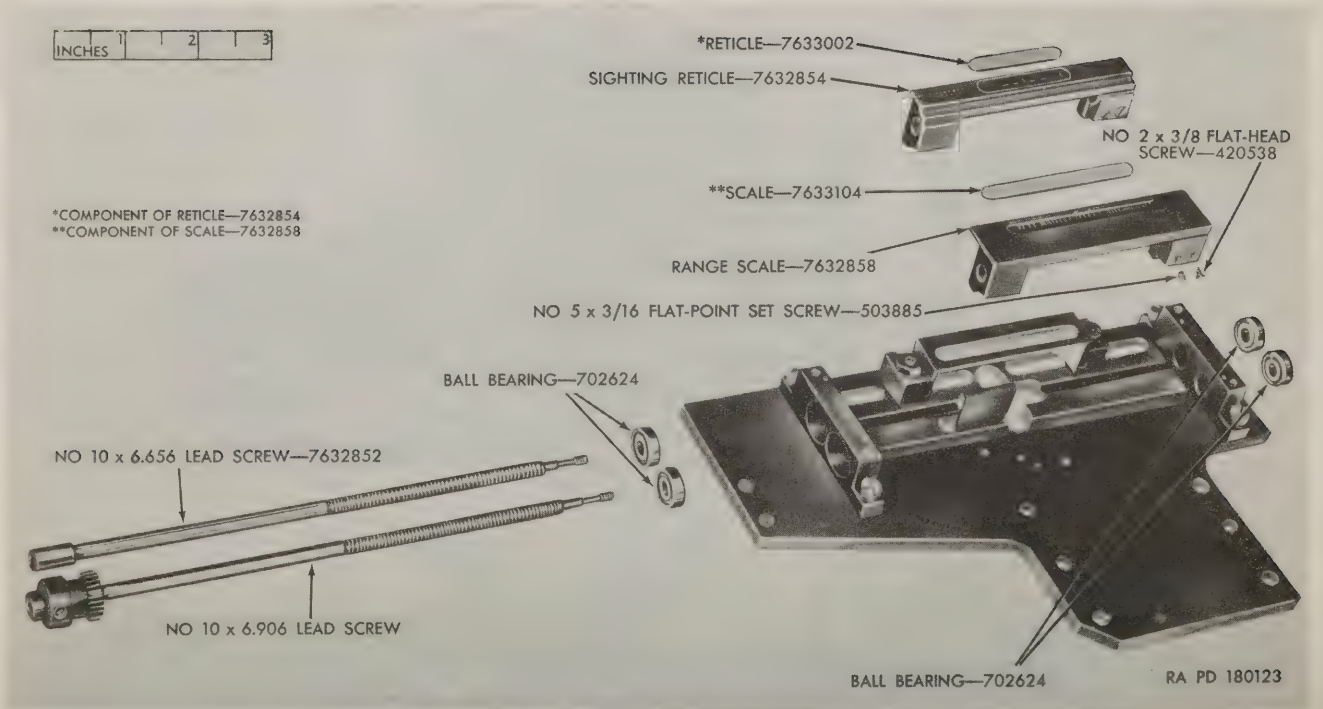


*Figure 184. Removal of lead screws, range scale, and sighting reticle.*

*g.* Follow the same procedure to remove the lead screw from the sighting reticle and the left sighting reticle bracket.

*h.* Tap the four ball bearings from the brackets.

*i.* Drive the straight pin (fig. 185) from the spur gear and lead screw. Slide the gear and the spring from the lead screw.

*j.* Unscrew the two slotted studs (fig. 186) and washers that secure the scale to the base. Remove the hex nuts and lift the ammo scale from the base. With a knife, remove scale 7633105 from the ammunition scale.

*k.* Unscrew the four fillister-head screws and lock washers that secure the sighting reticle brackets to the base. Pull both the brackets and the four straight pins from the base.

*l.* Unscrew the two fillister-head screws (fig. 187) and lock washers that secure the sighting reticle guide to the base. Lift the guide from the base and pull the straight pin from the base.

## 187. Disassembly of Mirror Assembly

Remove the staking from the retainers to the mirror bracket. Unscrew the two retainers (fig. 188) from the bracket, remove a ball from each retainer and pull the mirror from the bracket.

## 188. Disassembly of Correction Wedge Housing Assembly

*a.* Unscrew the four flat-head screws (fig. 189) that secure the plate to the housing and lift the plate, the flat spring, and plunger from the housing.

*b.* Remove the dog-point and the flat-point set screws from the housing (par. 56). Unscrew the ball cap from the housing using tubular wrench 41–W–3726–38 and slide the worm with the ball socket from the housing. Pull the socket from the worm.

*c.* Remove the two cone-point set screws (fig. 190) from the two clamping rings and unscrew the clamping rings from the housing using improvised 2.4-inch pin-type spanner wrench (fig. 51).

*d.* Remove the two cup-point set screws from the housing and slide the correction wedge gear assembly and the collimator correction wedge cell assembly from the housing.

*e.* Dissemble the correction wedge gear assembly as described in (1) and (2) below.

(1) Unscrew the retaining ring (fig. 191) from the gear (par. 60) using tubular wrench 41–W–3726–190. Break the seal between the gear and the wedge by inserting a thin blade between the gear and the wedge. Remove the wedge from the gear (par. 61*b*). Clean the sealing compound from the gear and the wedge (par. 63).

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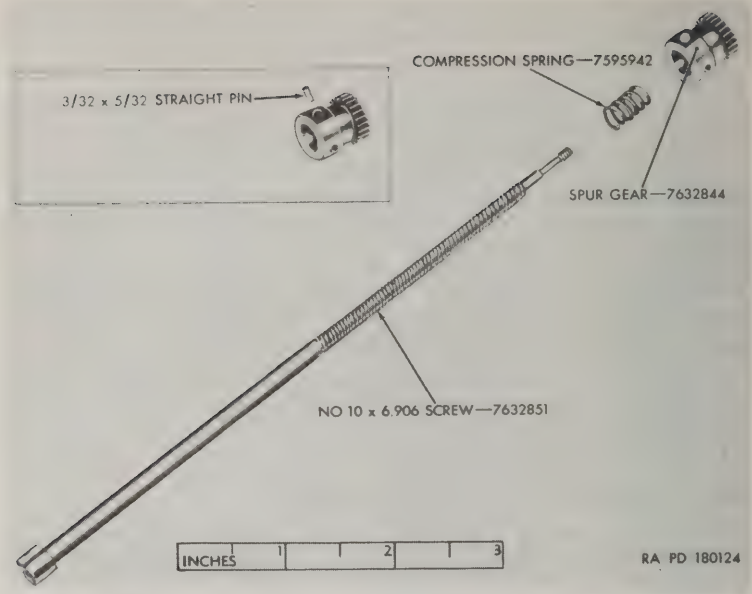


*Figure 185. Removal of spur gear and compression spring.*

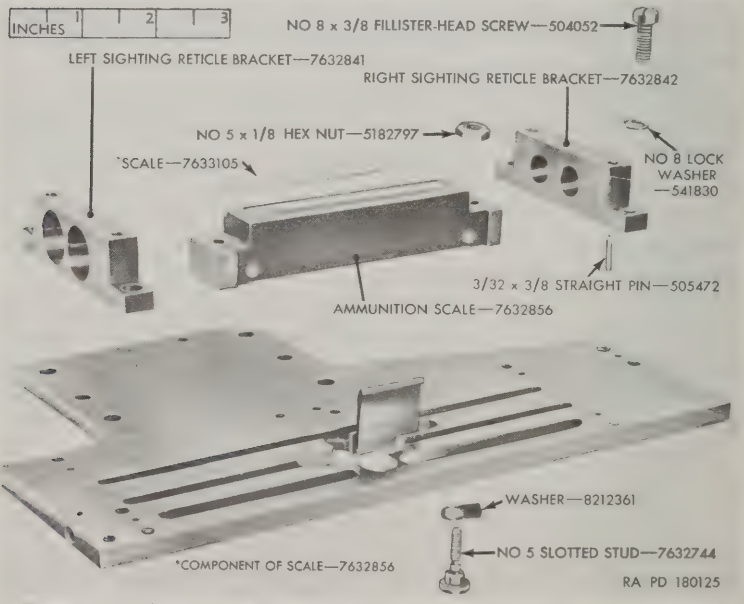


*Figure 186. Removal of ammunition scale and sighting reticle brackets.*

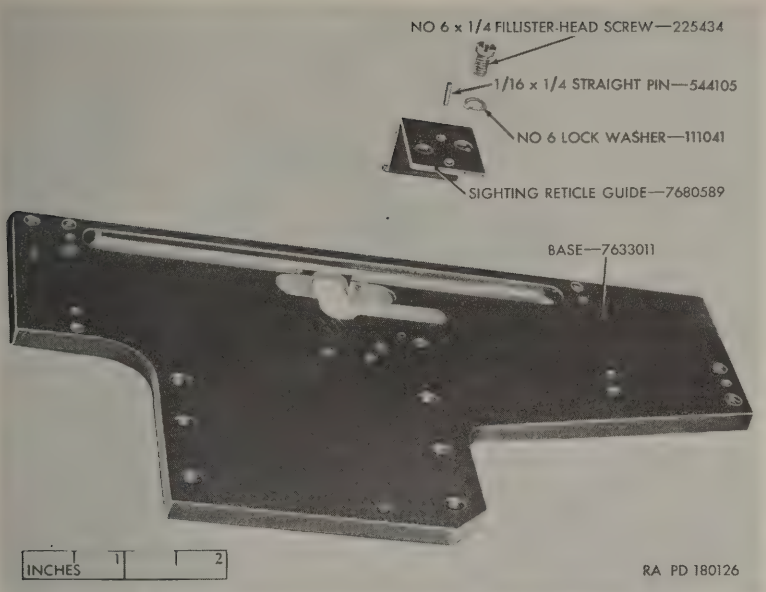


*Figure 187. Removal of sighting reticle guide.*

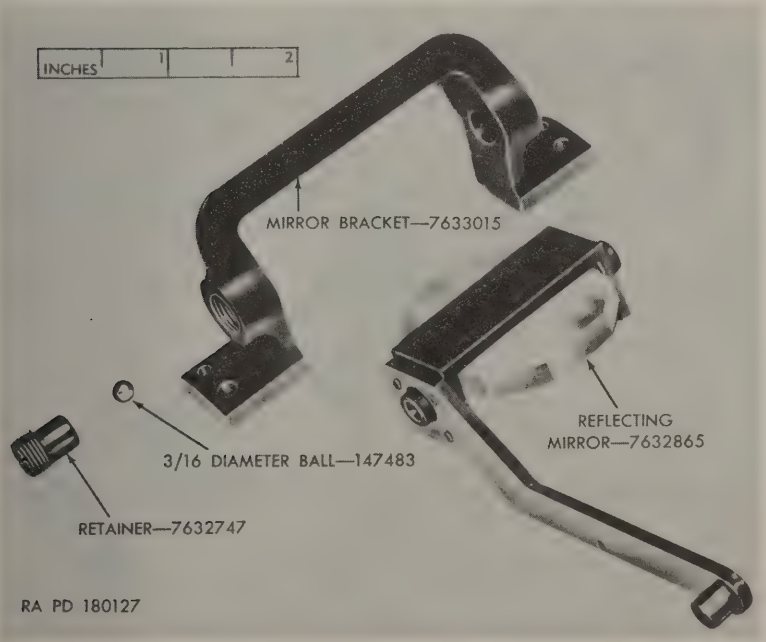


*Figure 188. Mirror assembly—exploded view.*

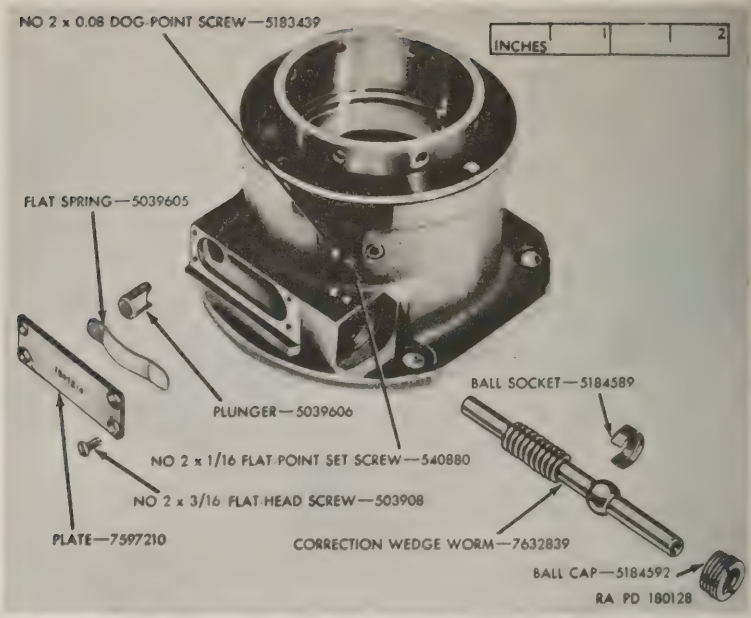


***Figure 189. Correction wedge housing assembly—partially exploded view.***

INCHES 1 2 3
CLAMPING RING —7632838
CORRECTION WEDGE GEAR ASSEMBLY —7632836
NO 10 X 3/16 CUP-POINT SET SCREW—140879
NO 5 X 5/32 CONE-POINT SET SCREW—540977
CORRECTION WEDGE HOUSING—7633110
COLLIMATOR CORRECTION WEDGE CELL ASSEMBLY—7632834
CLAMPING RING—7632838
RA PD 180129
NO 5 X 3/32 CONE-POINT SET SCREW—540977

***Figure 190. Correction wedge housing assembly—partially exploded view.***

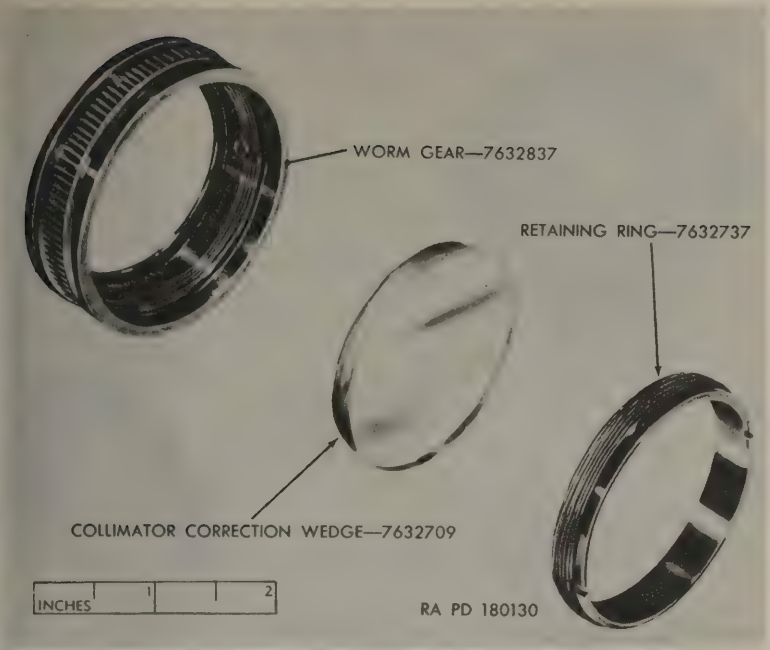


*Figure 191. Correction wedge gear assembly—exploded view.*

(2) Mark the wedge for identification (par. 61*d*) in reassembly.

*f.* To disassemble the collimator correction wedge cell assembly, follow the same procedure as for the disassembly of the gear assembly (fig. 192).

## 189. Disassembly of Beam-Splitter Rotating Bracket Assembly

Drive the taper pin (fig. 193) from the miter gear and the drive shaft (par. 59*a*). Pull the gear from the shaft, slide the shaft from the gear bracket, and tap the two ball bearings from the bracket.

## 190. Disassembly of Horizontal Reticle Drive Bracket Assembly

*a.* Drive the two taper pins (fig. 194) from the two bevel pinions (par. 59*a*). Drive a taper pin from the collar and pull the pinions and the collar from the shaft.

*b.* Slide the shaft from the bracket and tap the two ball bearings from the bracket.

*c.* Drive the two taper pins (fig. 195) from the miter and bevel gears and pull the gears from the shaft.

*d.* Slide the shaft from the bracket and tap the two ball bearings from the bracket.

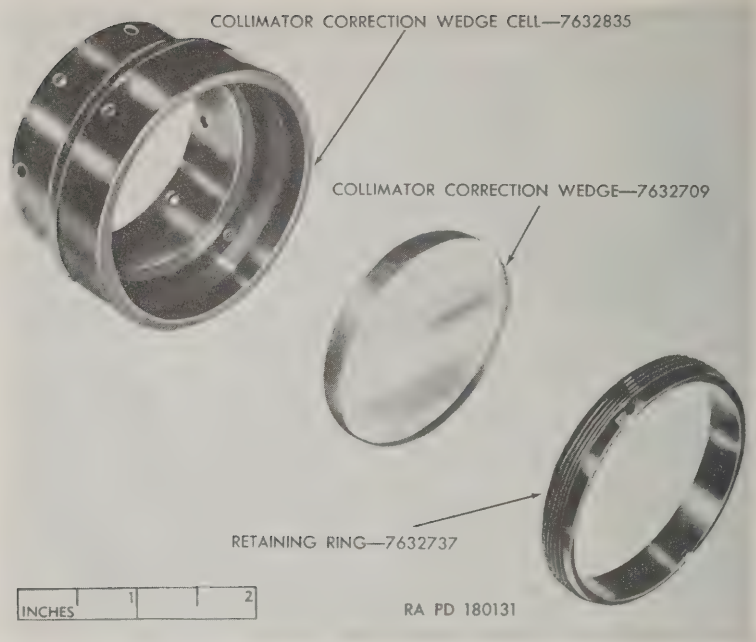


*Figure 192. Collimator correction wedge cell assembly—exploded view.*

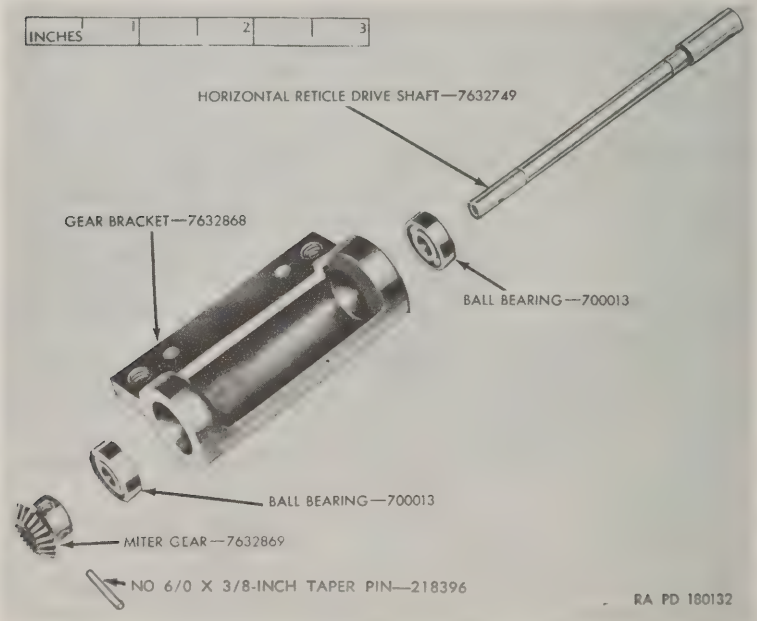


*Figure 193. Beam-splitter rotating bracket assembly—exploded view.*

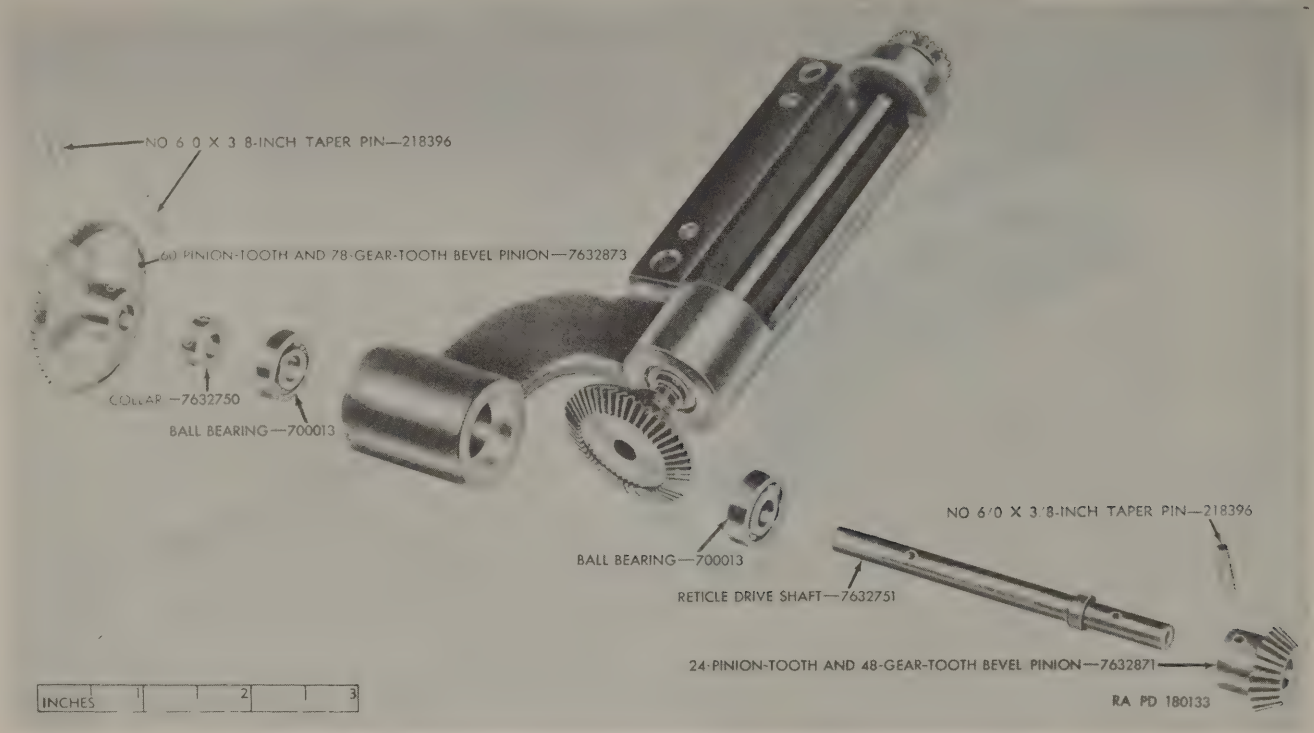
NO 6 0 X 3 8-INCH TAPER PIN—218396
60 PINION-TOOTH AND 78-GEAR-TOOTH BEVEL PINION—7632873
COLLAR—7632750
BALL BEARING—700013
BALL BEARING—700013
NO 6 0 X 3 8-INCH TAPER PIN—218396
RETICLE DRIVE SHAFT—7632751
24-PINION-TOOTH AND 48-GEAR-TOOTH BEVEL PINION—7632871
INCHES 1 2 3
RA PD 180133

*Figure 194. Horizontal reticle drive bracket assembly—partially exploded view.*

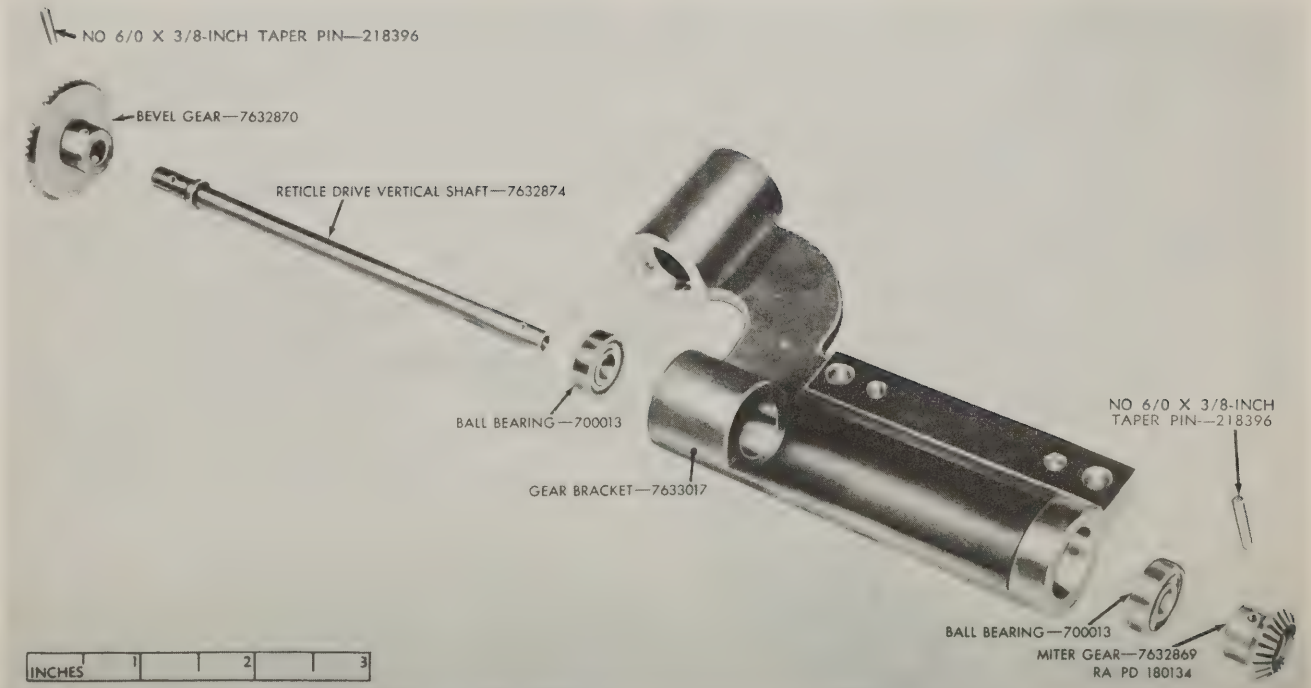


*Figure 195. Horizontal reticle drive bracket assembly—partially exploded view.*

## 191. Disassembly of Beam-Splitter Stop Bracket Assembly

Unscrew the clevis (fig. 196) from the bracket. Unscrew the two hex nuts from the hex-head screws and unscrew the two hex-head screws from the bracket.

## 192. Disassembly of Scale Transfer Prism Assembly

*a.* Pull the ball bearing (fig. 197) from the prism support. Remove the cup-point set screw from the support (par. 56) and pull the prism from the support.

*b.* Unscrew the three fillister-head screws and lock washers that secure the retainer to the support. Pull the retainer from the support and unscrew the clevis from the support.

## 193. Disassembly of Collimator Lens Alining Assembly

*a.* Scribe lines (par. 61*d*) on the cell assemblies (fig. 198) for alinement in reassembly, unscrew the set screw from the outer collimator lens cell assembly (par. 56) and pull the inner collimator lens cell assembly from the outer collimator lens cell assembly.

*b.* Disassemble the outer collimator lens cell assembly as described in (1) through (3) below.

(1) Unscrew the retaining ring (fig. 199) from the outer cell (par. 60) using tubular wrench 41–W–3726–190.

(2) Insert a thin blade between the lens and the cell to break the sealing compound and remove the lens from the cell (par. 61*b*) marking for identification (par. 61*d*) in reassembly.

(3) Clean the sealing compound from the lens and the cell (par. 63).

*c.* To disassemble the inner collimator lens cell, follow the same procedure as for the disassembly of the outer cell (fig. 200).

## 194. Disassembly of Plunger Assembly

Drive the straight pin (fig. 174) from the plunger and remove the ball bearing and the two plain washers from the plunger.

## 195. Disassembly of Reticle Assembly

*a.* Unscrew the three fillister-head screws (fig. 201) and lock washers that secure the retainer to the reticle housing. Remove the retainer.

*b.* Remove the eccentric from the drilled hole in the housing.

*c.* Remove the two cup-point set screws and slide the reticle cell assembly from the housing.

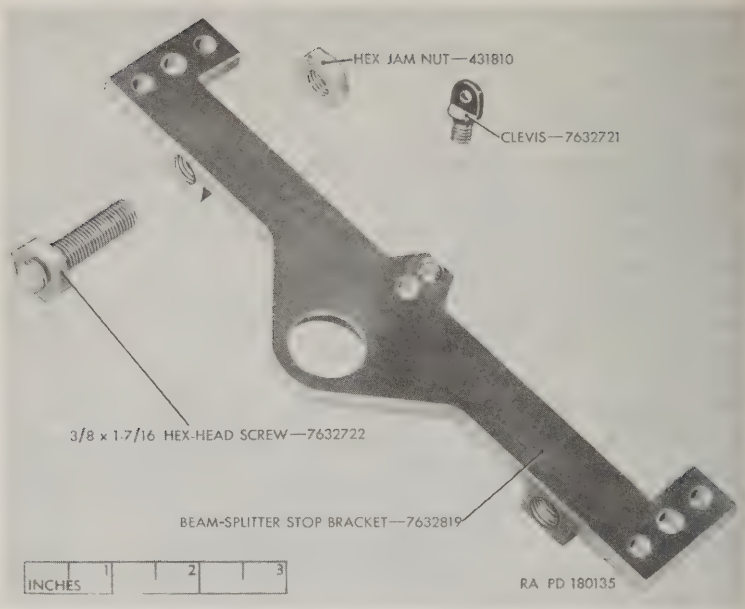


*Figure 196. Beam-splitter stop bracket assembly—exploded view.*

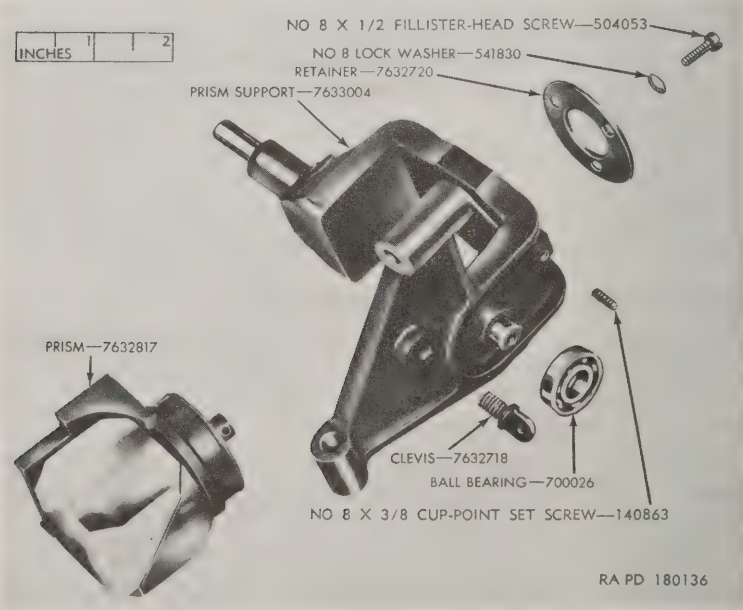


*Figure 197. Scale transfer prism assembly—partially exploded view.*

INNER COLLIMATOR LENS CELL ASSEMBLY—7632832
NO 10 x 5/32 CONE-POINT SET SCREW—540985
OUTER COLLIMATOR LENS CELL ASSEMBLY—7632830
INCHES
RA PD 180137

*Figure 198. Collimator lens alining assembly—exploded view.*

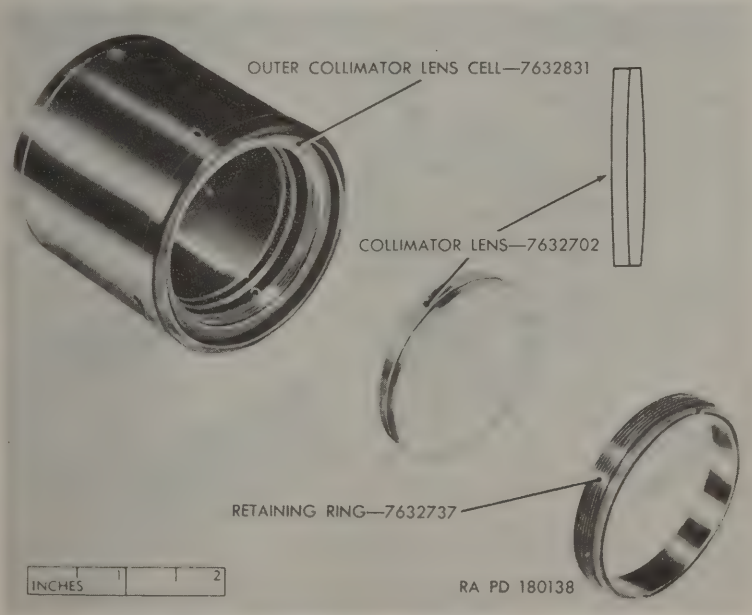


*Figure 199. Outer collimator lens cell assembly—exploded view.*

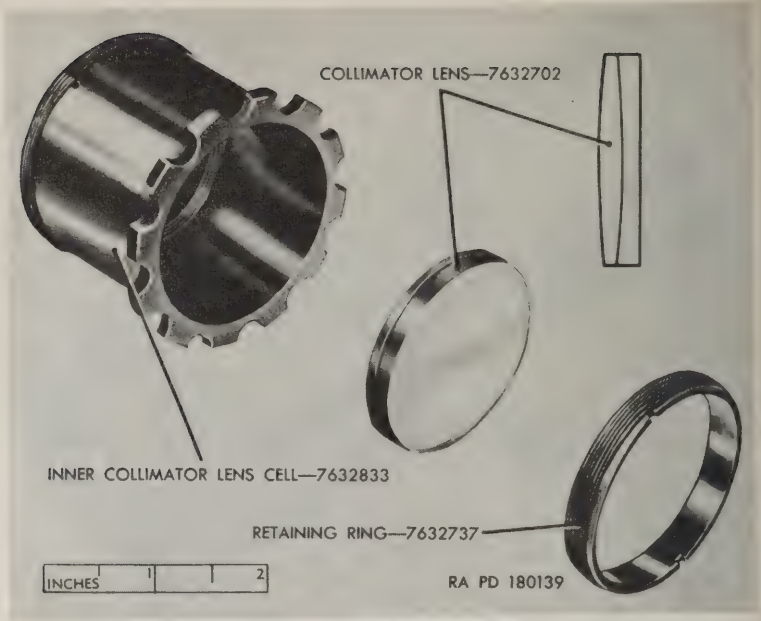


*Figure 200. Inner collimator lens cell assembly—exploded view.*

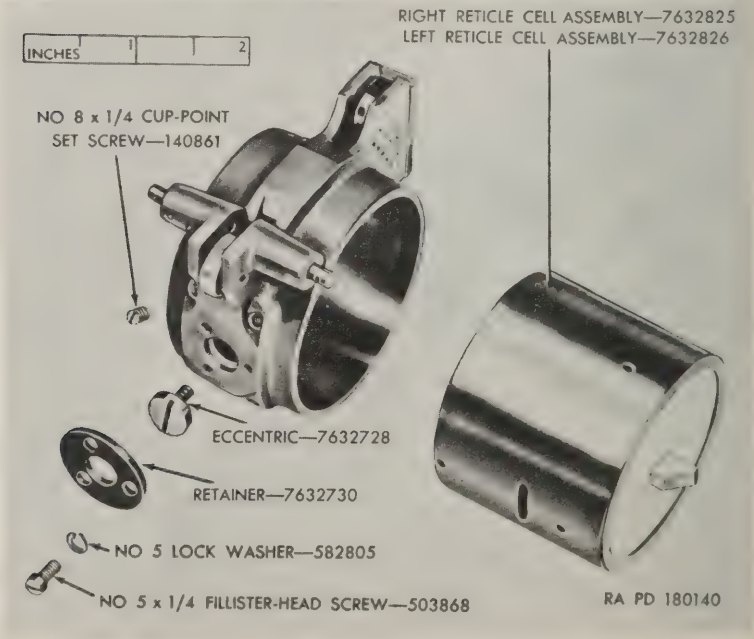


*Figure 201. Reticle assembly—exploded view.*

*d.* Disassemble the reticle cell assembly as described in (1) through (3) below.

(1) Unscrew the retaining ring (fig. 202) from the cell (par. 60) using tubular wrench 41–W–3726–240.

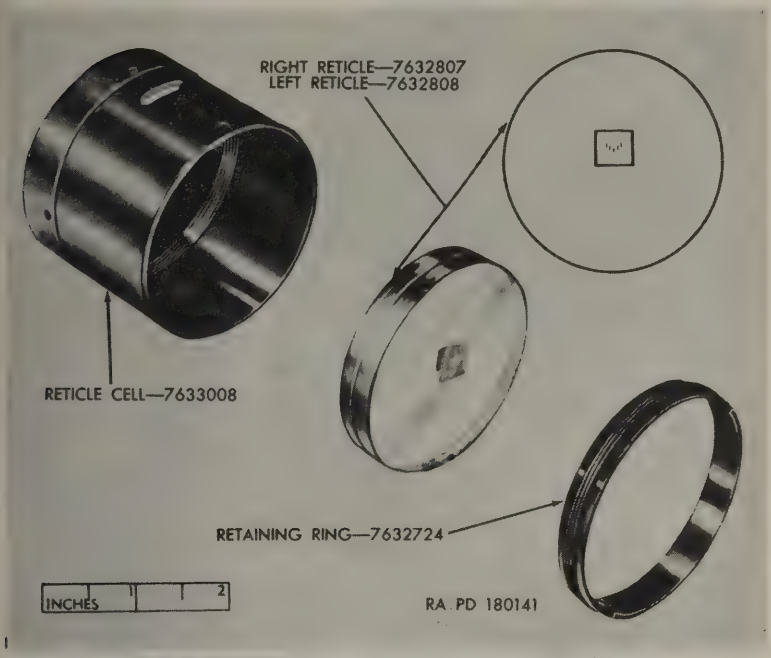


*Figure 202. Reticle cell assembly—exploded view.*

(2) Break the sealing compound by inserting a thin blade between the cell and the reticle, remove the reticle from the reticle cell (par. 61*b*) and mark for identification (par. 61*d*) in reassembly.

(3) Clean the sealing compound from the cell, the retaining ring, and the reticle (par. 63).

*e.* Unscrew the two fillister-head screws (fig. 203) that secure the plate to the reticle housing assembly and pull the plate from the housing assembly.

*f.* Disassemble the reticle housing assembly as described in (1) and (2) below.

(1) Drive the two straight pins (fig. 204) and the two ball bearings from the housing and the four plain washers fall free.

(2) Drive out the two straight pins that hold the two drilled straight pins. Drive the other two pins from the housing.

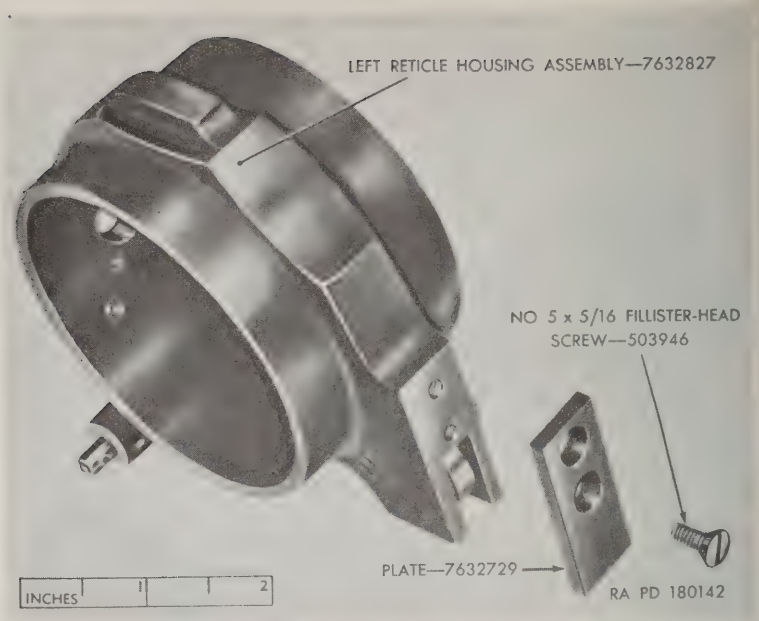


*Figure 203. Removal of plate.*

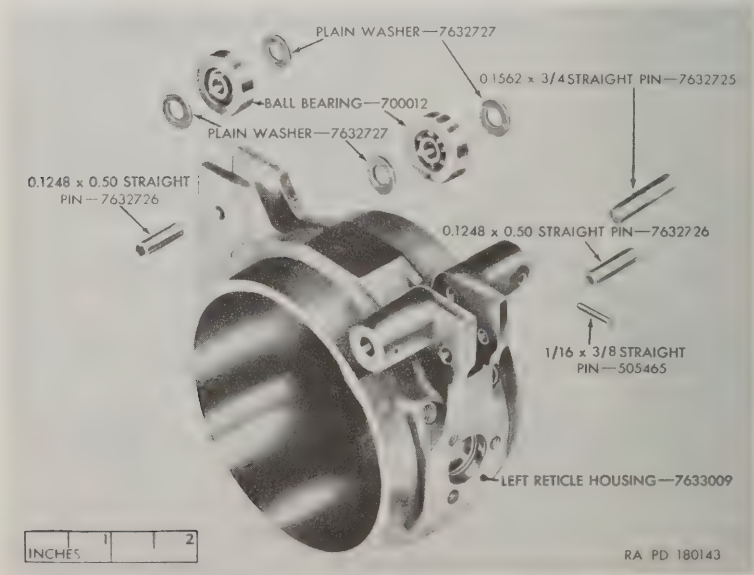


*Figure 204. Reticle housing assembly—exploded view.*

## Section VIII. DISASSEMBLY OF ASSEMBLIES OTHER THAN TELESCOPE, BALLISTIC CAM, AND COLLIMATOR ASSEMBLIES

### 196. Disassembly of End Housing Assembly

*a.* Remove the two flat-point set screws (fig. 205) from the end housing (par. 56) and unscrew the retaining ring from the housing (par. 60) using tubular wrench 41–W–3726–285.

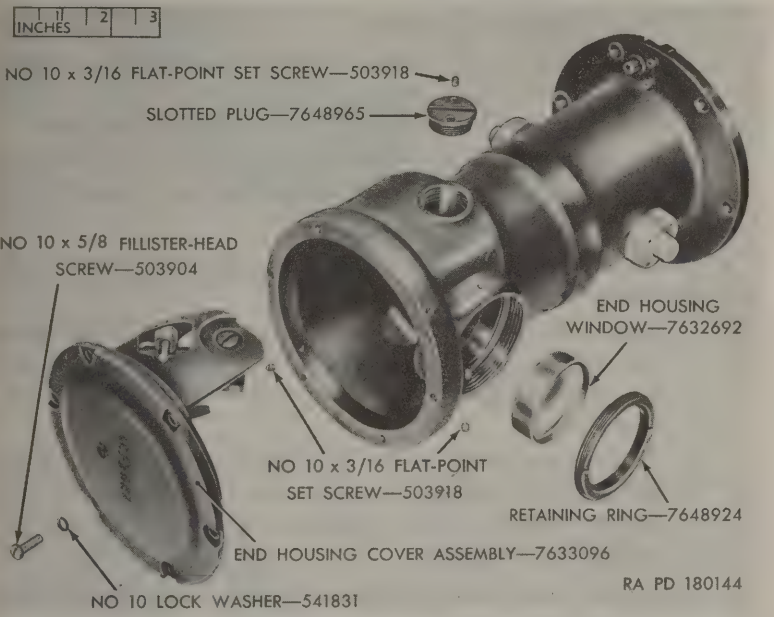
INCHES 1 2 3
NO 10 x 3/16 FLAT-POINT SET SCREW—503918
SLOTTED PLUG—7648965
NO 10 x 5/8 FILLISTER-HEAD SCREW—503904
END HOUSING WINDOW—7632692
NO 10 x 3/16 FLAT-POINT SET SCREW—503918
RETAINING RING—7648924
END HOUSING COVER ASSEMBLY—7633096
RA PD 180144
NO 10 LOCK WASHER—541831

*Figure 205. End housing assembly—exploded view.*

*b.* Remove the end housing window from the housing, marking it for identification purposes (par. 61*d*) for reassembly. Difficulty may be experienced in the removal due to the adhesion of the sealing compound and it may be necessary to break the compound by inserting a thin blade between the window and the housing.

*c.* Clean the sealing compound from the window and the housing (par 63).

*d.* Remove the two flat-point set screws from the slotted plug, unscrew the plug, using tubular wrench 41–W–3726–98. Clean the sealing compound from the plug and the housing.

*e.* Remove the end housing cover assembly as described in (1) and (2) below.

(1) Unscrew the six fillister-head screws and lock washers that secure the cover assembly to the end housing.

(2) Remove the four flat-point set screws from the injection sealing ports in the housing, pry the cover assembly from the housing, and clean the sealing compound from the cover and the housing.

*f.* Disassemble the end housing cover assembly as described in (1) through (3) below.

(1) Drive the spring pin (fig. 206) from the fillister-head screw. Remove the screw and the spherical washer that secure the penta reflector to the cover.

(2) Remove the two flat-point set screws that secure the straight pin to the penta reflector and remove the two flat-point set screws (par. 56) that secure the straight pin to the cover.

(3) Drive the straight pin from the cover and the penta reflector. Pull the reflector from the cover and the compression spring will fall free.

*g.* Remove the azimuth correction cell assembly as described in (1) and (2) below.

(1) Remove the four flat-point set screws (fig. 207) that secure the cell assembly to the end housing. Break the cell assembly loose using improvised cell assembly wrench 7633137 (fig. 208).

(2) Remove the two set screws from the injection sealing ports and clean the sealing compound from the cell assembly and the end housing. Use a brass wire in the sealing ports to remove the compound.

*h.* To remove the cycle valve and the valve cap, refer to paragraph 117 and follow the same procedure as in the removal of the cycle valve and the valve cap from the maining housing.

*i.* Disassemble the azimuth correction cell assembly as described in (1) and (2) below.

(1) Unscrew the retaining ring (fig. 209) from the azimuth correction cell (par. 60). Remove the correction wedge from the cell and mark for identification (par. 61*d*) in reassembly. It may be necessary to slide a thin blade between the wedge and the cell to break the seal.

(2) Clean the sealing compound from the wedge, the retaining ring, and the cell (par. 63).

*j.* Unscrew the six socket-head screws and lock washers (fig. 210) that secure the keys to the end housing. Pull the four keys from the housing and drive the two straight pins from the housing.

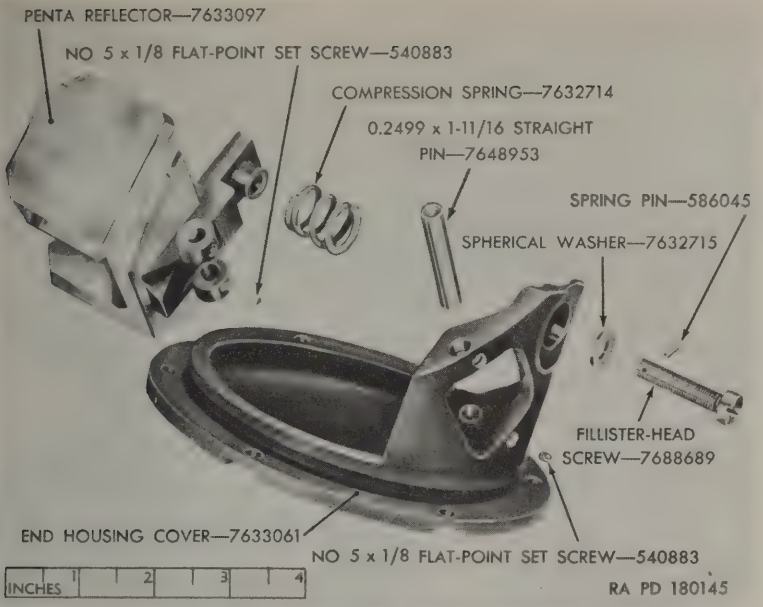


*Figure 206. End housing cover assembly—exploded view.*

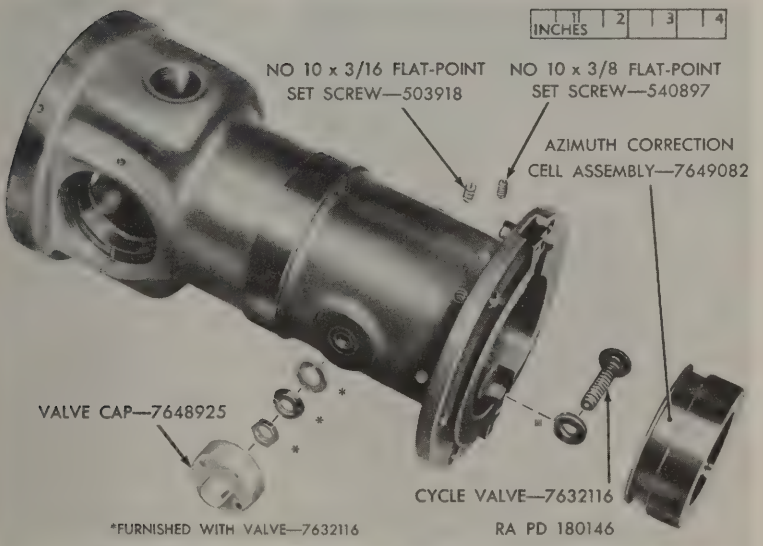
INCHES 1 2 3 4
NO 10 x 3/16 FLAT-POINT SET SCREW—503918
NO 10 x 3/8 FLAT-POINT SET SCREW—540897
AZIMUTH CORRECTION CELL ASSEMBLY—7649082
VALVE CAP—7648925
CYCLE VALVE—7632116
*FURNISHED WITH VALVE—7632116
RA PD 180146

*Figure 207. Removal of azimuth correction cell assembly.*

*Figure 208. Use of the improvised cell assembly wrench 7633137.*

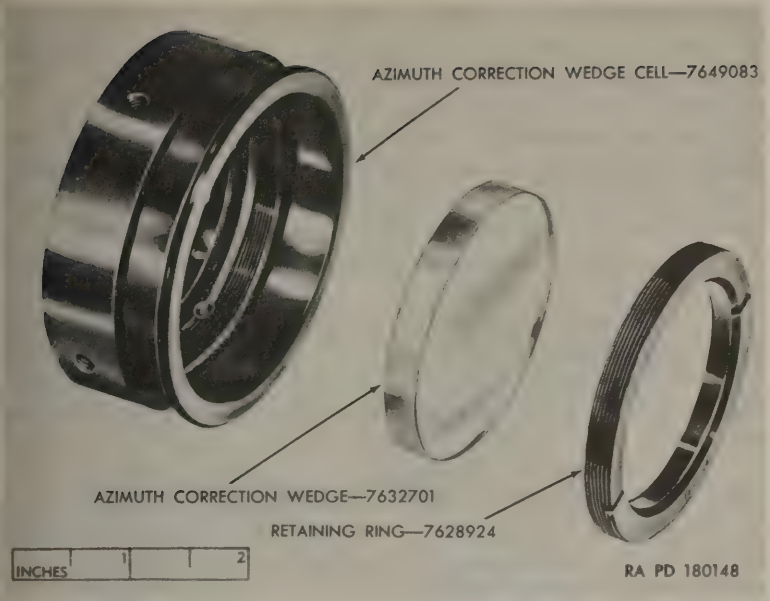


*Figure 209. Azimuth correction cell assembly—exploded view.*

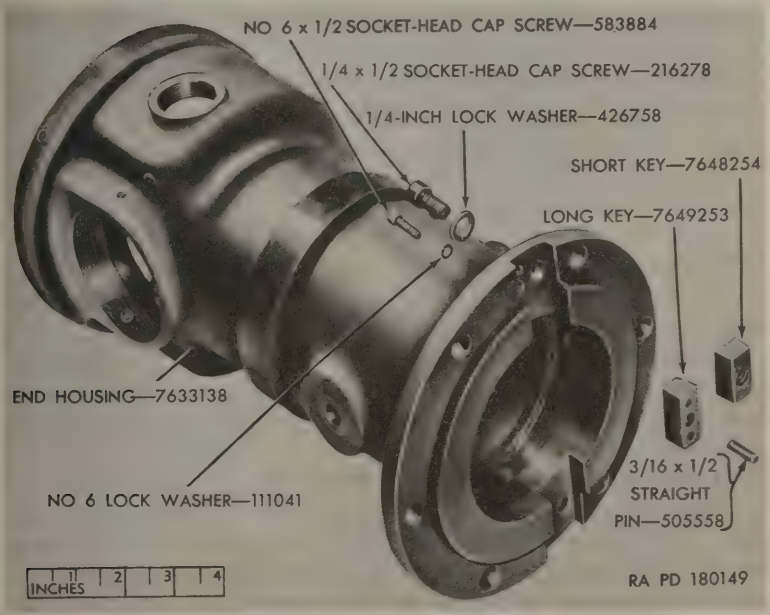


*Figure 210. Removal of keys.*

## 197. Disassembly of Upper Link Connector Assembly

*a.* Remove the flat-point set screw (fig. 211) from the upper link connector (par. 56). Unscrew the retainer from the connector with an improvised $1\frac{11}{16}$-inch pin-type spanner wrench (fig. 54).

*b.* Tap the eccentric stud from the connector and slide the stud, the eccentric sleeve, and the related parts from the connector as a unit.

*Note.*—The first range finders manufactured did not have a stud with a sleeve. These new parts will be substituted when possible in servicing.

*c.* Pry a prong of the lock washer from the groove in the lock nut and unscrew the nut from the stud.

*d.* Slide off the washer, spring washer, ball bearing, spacer, and the second bearing from the stud.

*e.* Pull the straight pin and remove the set screw from the sleeve. Slide the sleeve from the stud and pry the plain washer from the connector.

## 198. Disassembly of Lower Link Connector Assembly

*a.* Remove the cone-point set screw (fig. 212) from the lower connector (par. 56) and unscrew the retainer from the connector using tubular wrench 41–W–3726–113.

*b.* Pry a prong of the lock washer from the groove of the lock nut, unscrew the nut from the eccentric stud, and slide the lock washer, two ball bearings and the spacer from the stud.

*c.* Tap the eccentric stud with the eccentric sleeve from the connector.

*d.* Pull out the straight pin and remove the set screw from the sleeve and slide the stud from the sleeve.

*Note.*—First range finders manufactured did not have the stud with the sleeve. These parts will be substituted in older models when possible in servicing.

*e.* Pry the plain washer from the connector.

## 199. Disassembly of Halving Knob Assembly

*a.* Drive the taper pin (fig. 213) from the halving knob (par. 59*a*) and pull the knob from the shaft.

*b.* Remove the two stop rings from the knob housing. Drive the taper pin and remove the set screw from the gear, slide the gear from the shaft, and slide the shaft from the housing.

## 200. Disassembly of ICS Knob Assembly

*a.* Remove the cone-point set screw (fig. 214) from the ICS knob (par. 56). Unscrew the fillister-head screw and the slotted round nut from the knob shaft and pull the knob from the shaft.

*b.* Drive the taper pin from the knob detent (par. 59*a*) and slide the detent from the shaft.

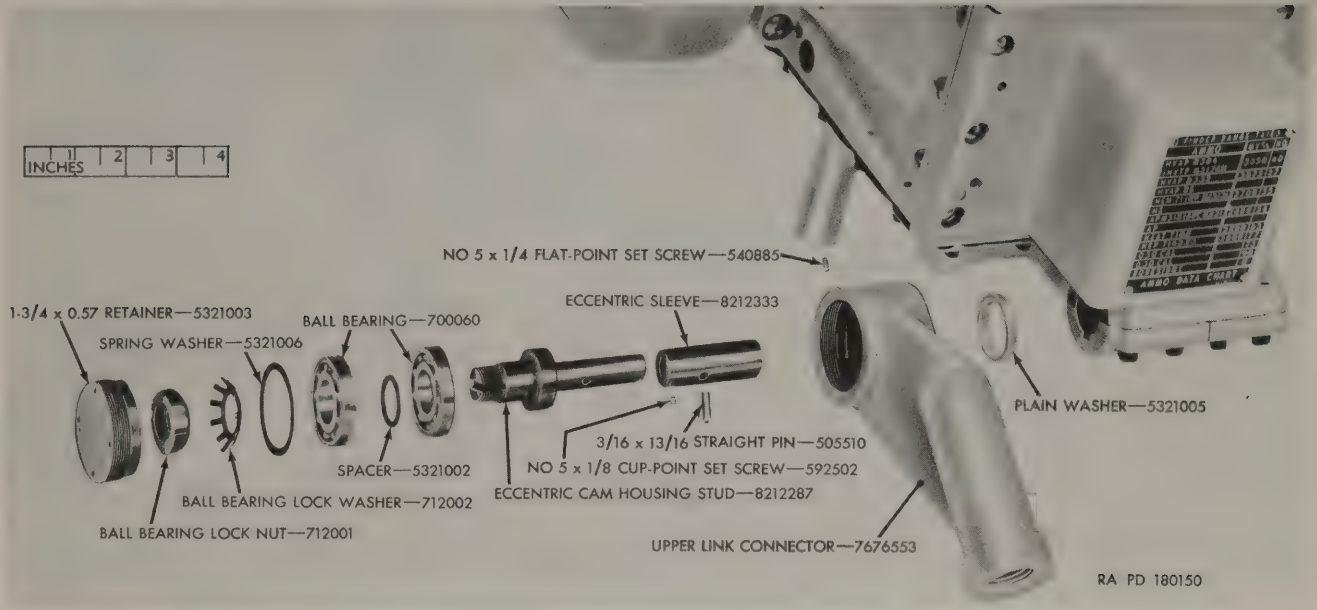


*Figure 211. Upper link connector assembly—exploded view.*

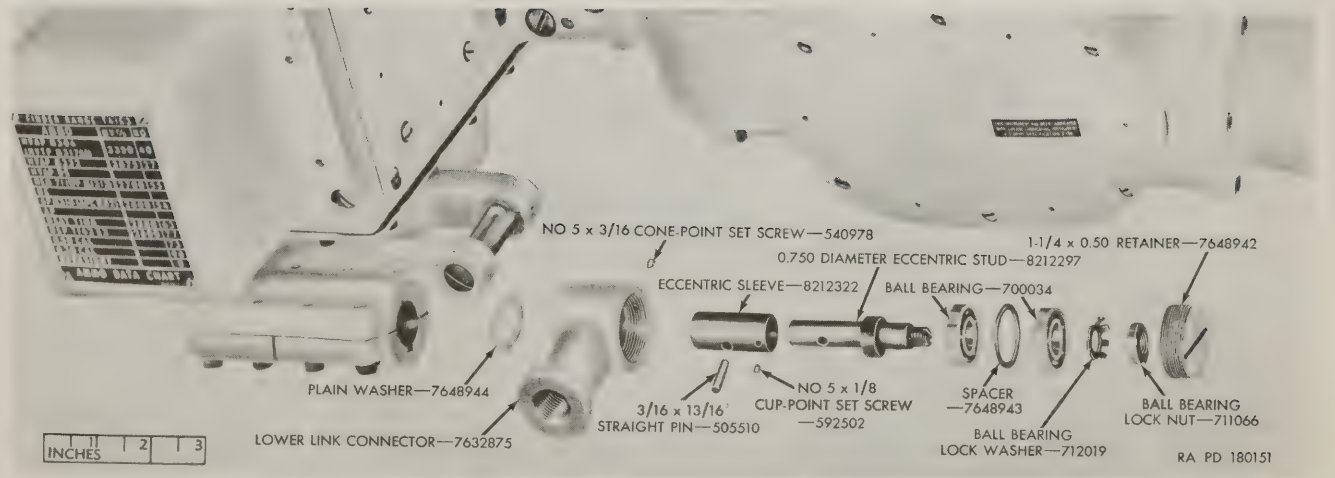


*Figure 212. Lower link connector assembly—exploded view.*

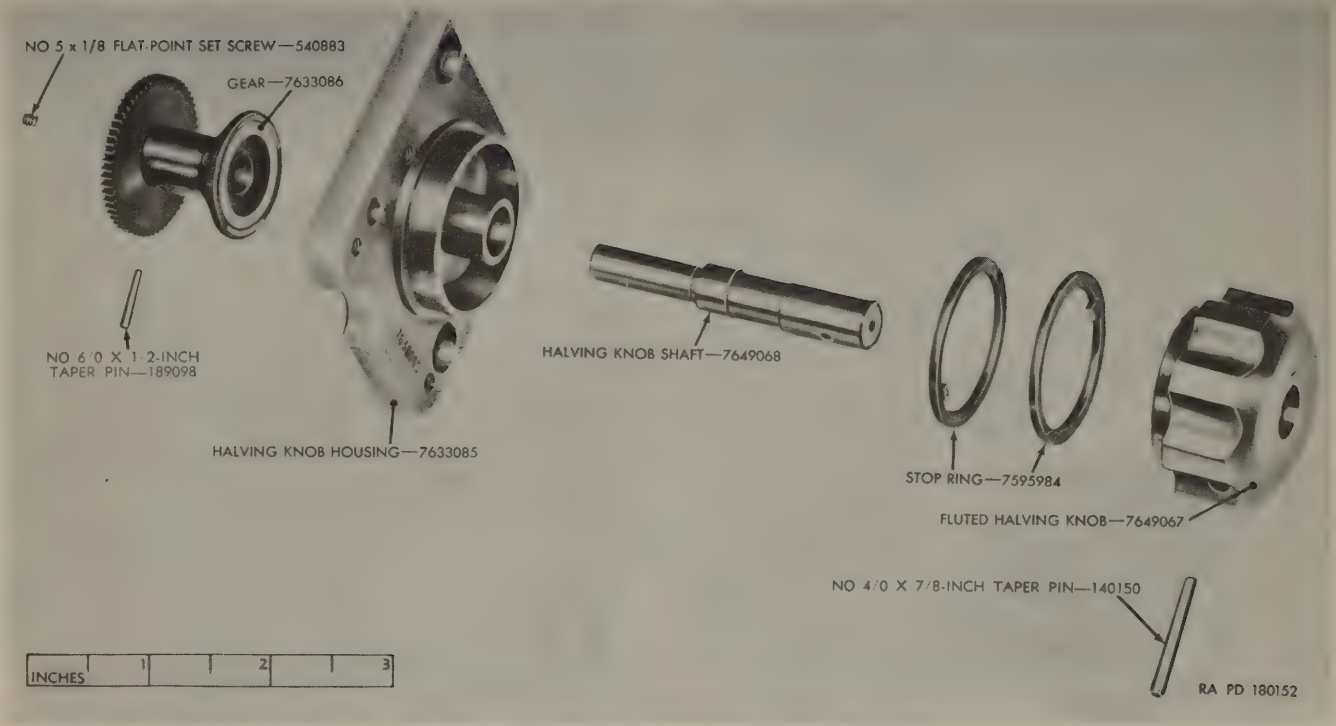


*Figure 213. Halving knob assembly—exploded view.*

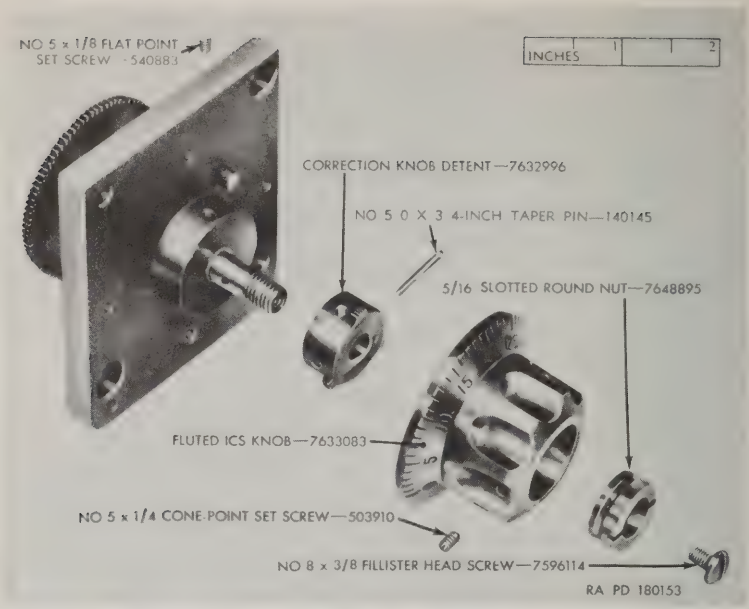
NO 5 x 1/8 FLAT POINT SET SCREW - 540883
INCHES 1 2
CORRECTION KNOB DETENT—7632996
NO 5 0 X 3 4-INCH TAPER PIN—140145
5/16 SLOTTED ROUND NUT—7648895
FLUTED ICS KNOB—7633083
NO 5 x 1/4 CONE-POINT SET SCREW—503910
NO 8 x 3/8 FILLISTER HEAD SCREW—7596114
RA PD 180153

*Figure 214. ICS knob assembly—partially exploded view.*

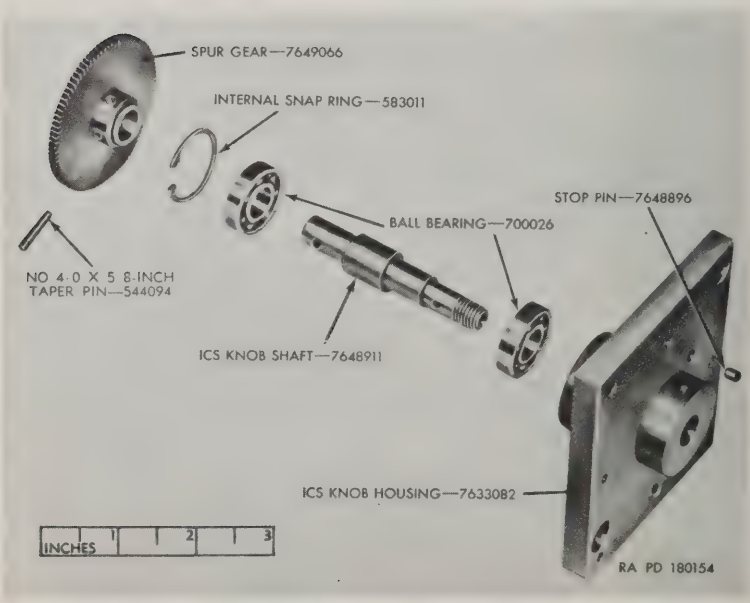


*Figure 215. ICS knob assembly—partially exploded view.*

*c.* Remove the set screw (par. 56) from the knob assembly.

*d.* Drive the taper pin (fig. 215) from the spur gear and slide the gear from the shaft.

*e.* Compress the snap ring with snap ring pliers, lift the ring from the housing. Slide the shaft from the housing and slide the ball bearing from the shaft.

*f.* Tap the other bearing from the housing, drill out the riveted stop pin.

## 201. Disassembly of Ballistic Correction Knob Assembly

*a.* Remove the cone-point set screw (fig. 216) from the ballistic knob (par. 56). Unscrew the fillister-head screw and the slotted round nut from the shaft, and pull the knob from the shaft.

*b.* Unscrew the fillister-head screw from the other end of the shaft, slide the two lock washers and the three plain washers from the screw. The compression spring will fall free. Slide the locking gear from the shaft.

*c.* Drive the taper pin (fig. 217) from the knob detent (par. 59*a*) and slide the detent from the shaft.

*d.* Unscrew the three fillister-head screws and lock washers from the clutch. Pull the clutch from the housing, slide the clutch and the spacer from the shaft, and slide the shaft from the housing.

*e.* Drive the straight pin from the shaft, slide the two ball bearings from the shaft.

*f.* Pull the straight pin that locates the clutch on the housing and remove the riveted stop pin by drilling.

*g.* Unscrew the flat-point set screws from the housing.

## 202. Disassembly of Spare Lamp Box Assembly

*a.* Drive the straight pin (fig. 218) from the spare lamp box to release the torsion spring.

*b.* Drive the other straight pin from the box and pull the knob assembly and the spring from the box.

*c.* Drive the straight pin and pull the cover from the box.

*d.* Unscrew the two fillister-head screws and lockwashers that secure the plate to the cover and pull the plate from the cover.

*e.* Drill the two rivets and remove the nameplate from the cover.

## 203. Disassembly of Left Reticle Lamp Housing Assembly

*a.* Drive the straight pins (fig. 219) from the housing and remove the knob assembly and the cover.

*b.* Unscrew the retaining ring from the housing (par. 60) using tubular wrench 41–W–3726–38. Remove the condenser lens from the housing (par. 61*b*).

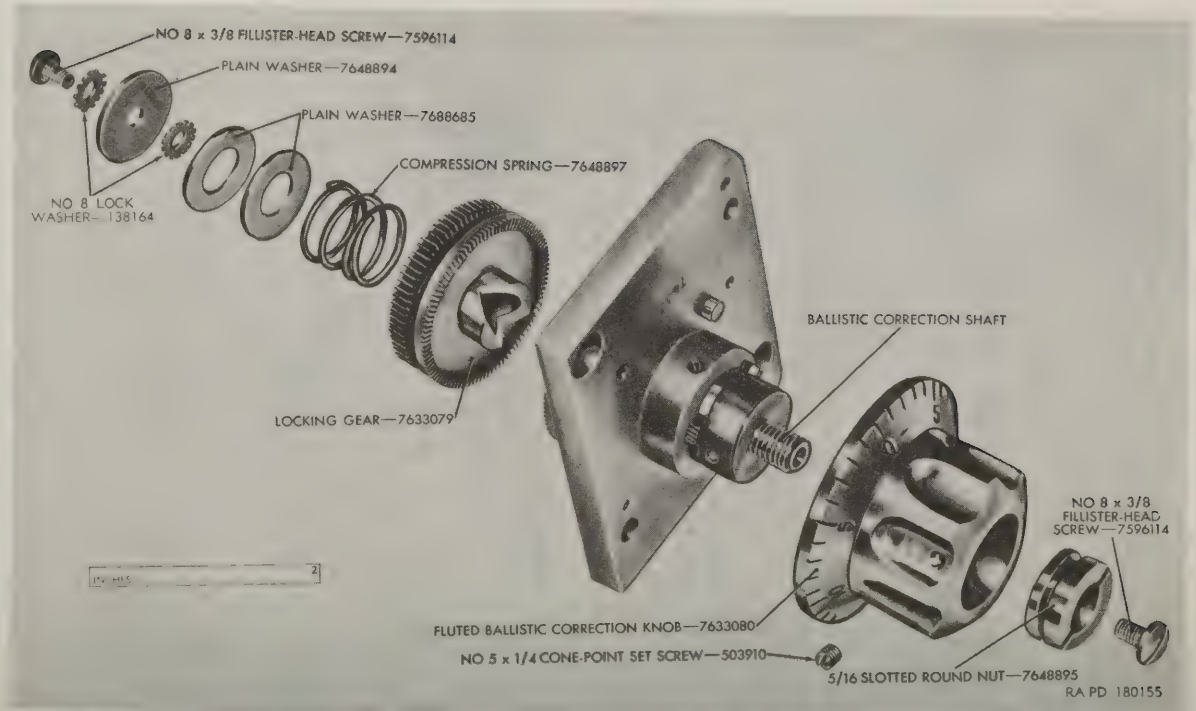


*Figure 216. Ballistic correction knob assembly—partially exploded view.*

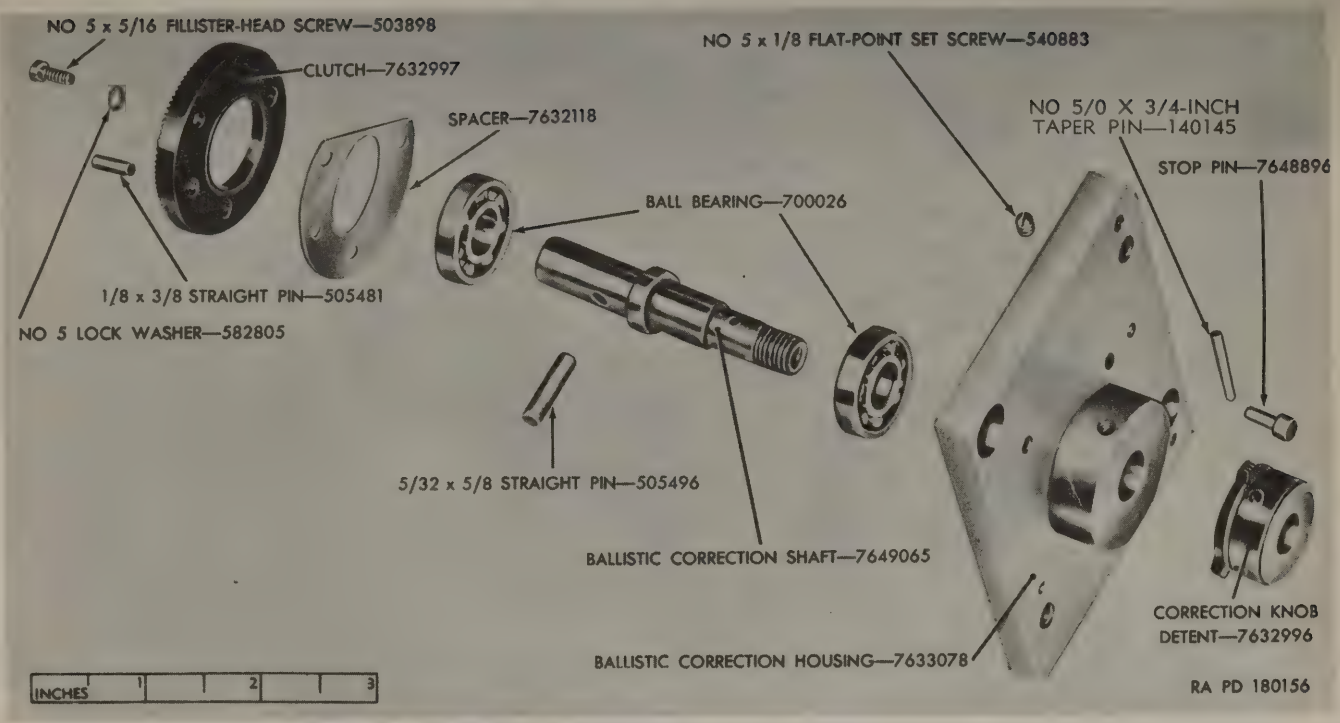


*Figure 217. Ballistic correction knob assembly—partially exploded view.*

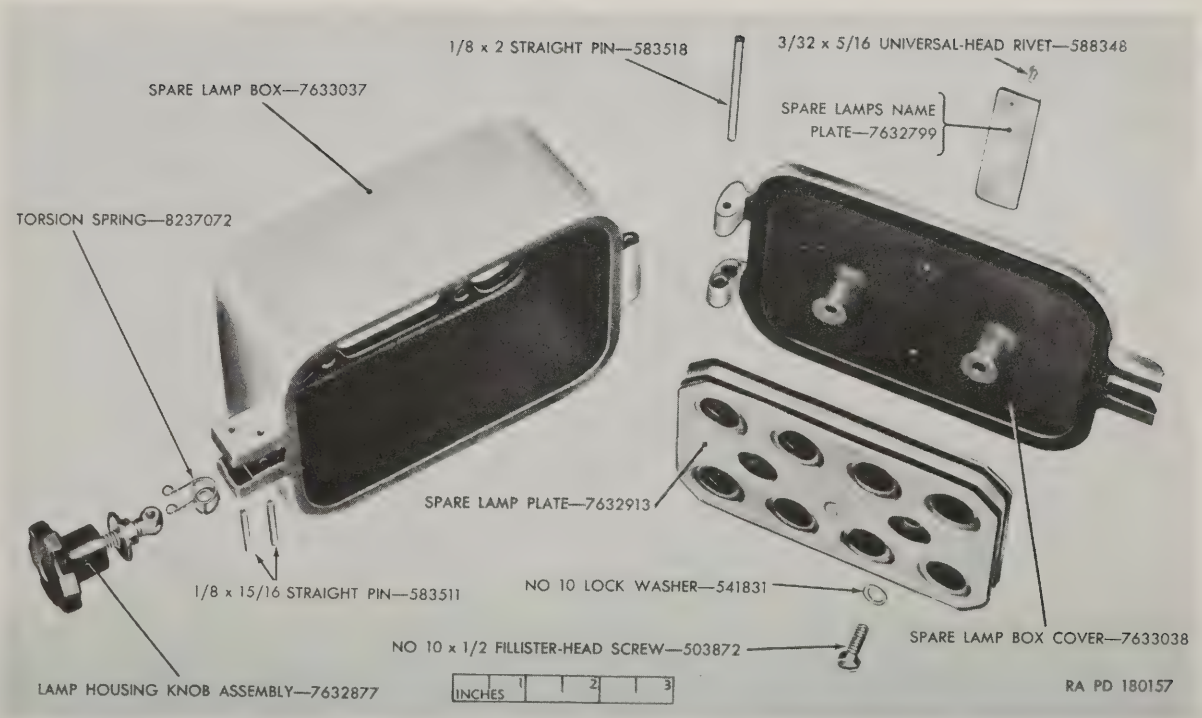
1/8 x 2 STRAIGHT PIN—583518
3/32 x 5/16 UNIVERSAL-HEAD RIVET—588348
SPARE LAMP BOX—7633037
SPARE LAMPS NAME PLATE—7632799
TORSION SPRING—8237072
SPARE LAMP PLATE—7632913
1/8 x 15/16 STRAIGHT PIN—583511
NO 10 LOCK WASHER—541831
SPARE LAMP BOX COVER—7633038
NO 10 x 1/2 FILLISTER-HEAD SCREW—503872
LAMP HOUSING KNOB ASSEMBLY—7632877
INCHES 1 2 3
RA PD 180157

*Figure 218. Spare lamp box assembly—exploded view.*

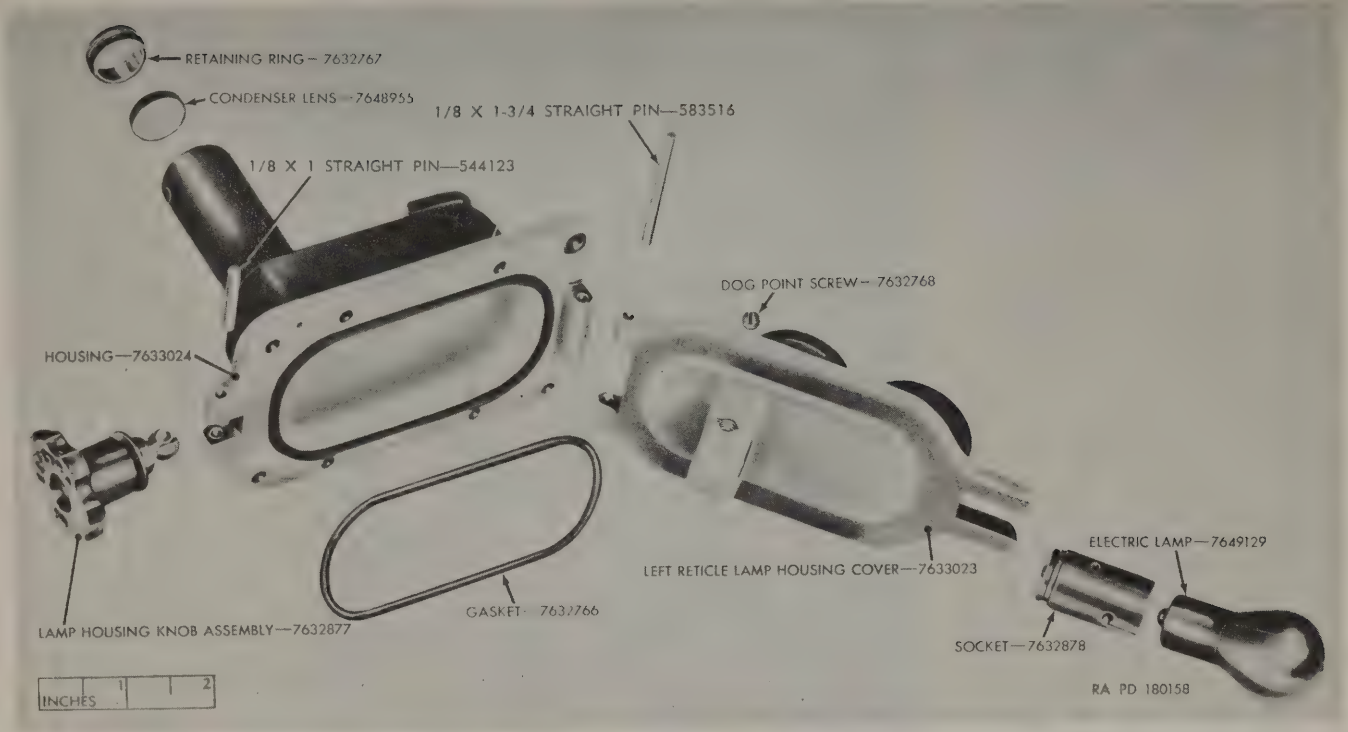


*Figure 219. Left reticle lamp housing assembly—exploded view.*

*c.* Clean the sealing compound from the lens, the ring, and the housing (par. 63) and mark the identification (par. 61*d*) of the lens for reassembly.

*d.* Remove the dog-point set screw (par. 56) from the cover, pull the socket from the cover, and remove the lamp from the socket.

*e.* Pull the gasket from the cover carefully to avoid damage, and clean the cement from the gasket and the cover (par. 63).

## 204. Disassembly of Right Reticle Lamp Housing Assembly

*a.* Drive a straight pin from the housing (fig. 220) and pull the knob assembly from the housing. Drive two straight pins from the cover and pull the cover from the housing.

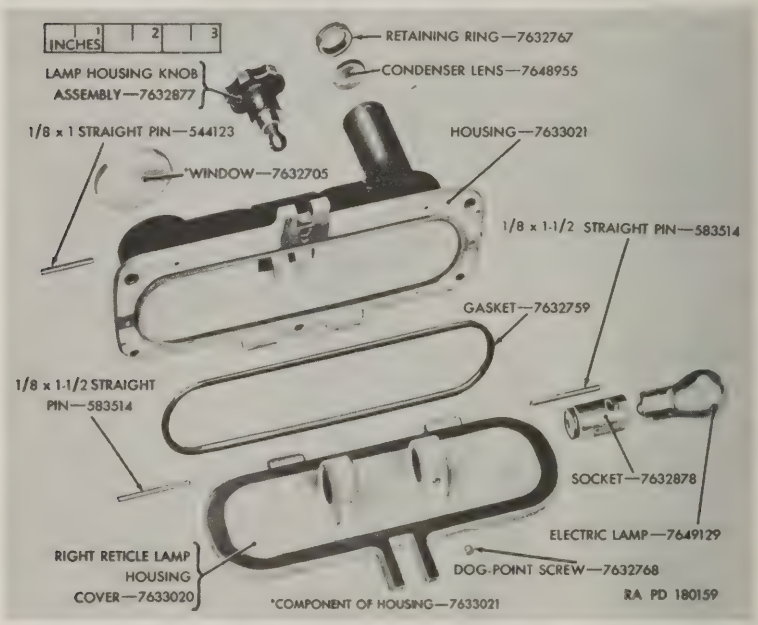


*Figure 220. Right reticle lamp housing assembly—exploded view.*

*b.* Remove the two dog-point set screws from the cover (par. 56), and remove the two sockets from the cover. Remove the two lamps from the sockets.

*c.* Pull the gasket carefully from the cover to avoid damage. Clean the cement from the cover and the gasket (par. 63).

*d.* Unscrew the retaining ring from the housing (par. 60) using tubular wrench 41–W–3726–38 and remove the condenser lens from

the housing (par. 61*b*). It may be necessary to insert a thin blade between the lens and the housing to break the seal.

*e.* Clean the sealing compound from the lens, the housing, and the retaining ring (par. 63) and identify the lens for reassembly (par. 61*d*).

### 205. Disassembly of Scale Transfer Prism Lever Assembly

*a.* Drive the taper pin (fig. 221) from the prism lever (par. 59*a*) and remove the lever from the arm. Tap the key from the arm and slide the arm from the lever housing.

*b.* Tap the two ball bearings and the spacer from the housing.

*c.* Unscrew the two set screws from the housing (par. 56).

### 206. Disassembly of Reticle Adjustment Housing Assembly

Pull the cover from the shaft (fig. 222) and drive the taper pin from the pinion (par. 59*a*). Pull the pinion from the shaft and remove the shaft from the housing. Unscrew the two flat-point set screws from the housing.

### 207. Disassembly of Lower Front Control Panel Assembly

Drill four riveted stop pins (fig. 223) from the panel.

### 208. Disassembly of Adapter Plate Assembly

*a. Removal of Ammo Knob and Related Parts.*

(1) Unscrew the fillister-head screw (fig. 224) from the knob shaft and remove the cone-point set screw from the knob (par. 56). Unscrew the slotted round nut from the shaft and pull the ammo knob from the shaft.

(2) Drive the taper pin from the detent (par. 59*a*) and slide the detent from the shaft.

(3) Drill out the riveted stop pin from the plate and remove the two set screws from the sealing ports in the plate.

(4) Unscrew the fillister-head screw (fig. 225) from the shaft. Remove two lock and three plain washers, and slide the compression spring, and the locking gear from the shaft.

(5) Unscrew the three fillister-head screws (fig. 226) and lockwashers from the clutch. Slide the clutch and the spacer from the shaft and slide the shaft from the adapter plate.

(6) Drive the straight pin from the shaft and remove the ball bearing. Tap the other ball bearing from the plate and pull the straight pin from the plate.

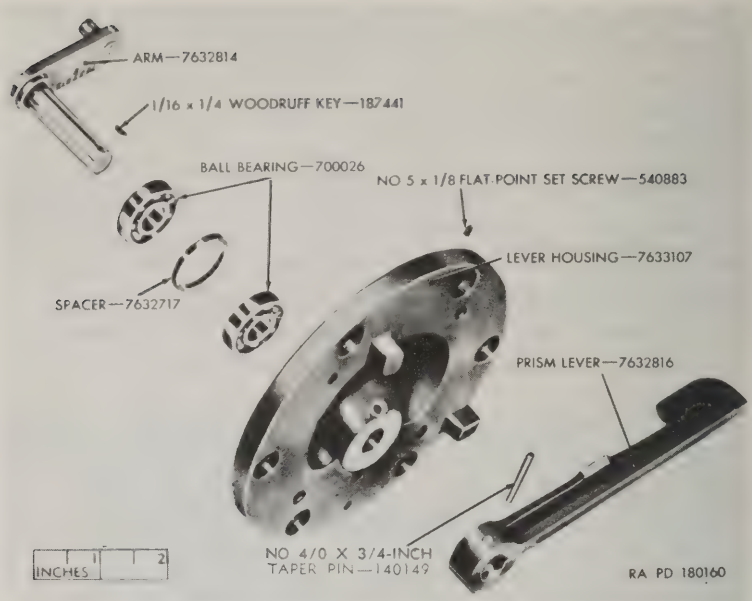


*Figure 221. Scale transfer lever prism assembly—exploded view.*

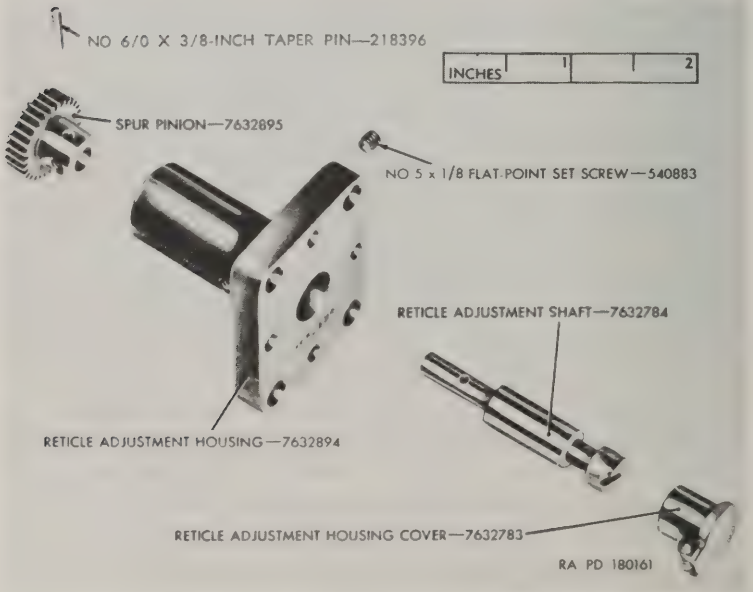


*Figure 222. Reticle adjustment housing assembly—exploded view.*

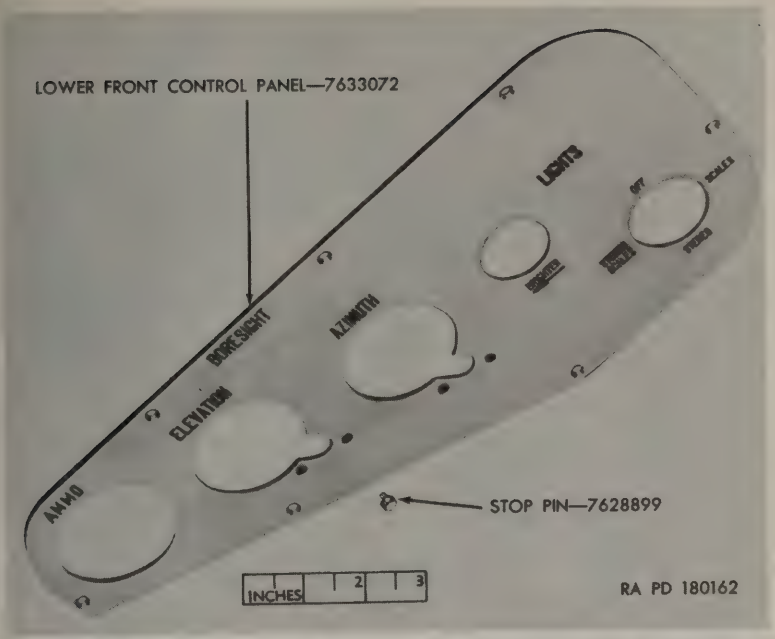


*Figure 223. Lower front control panel assembly—exploded view.*

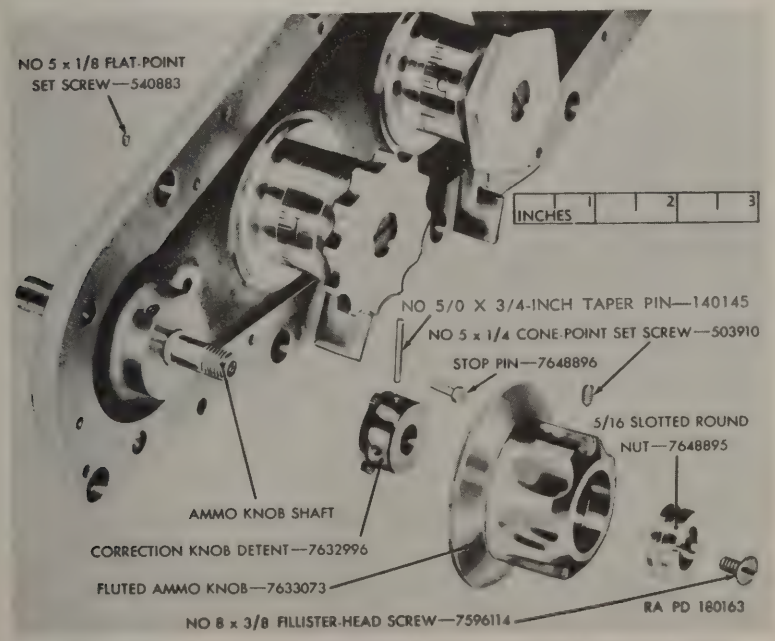


*Figure 224. Ammo knob and related parts—partially exploded view.*

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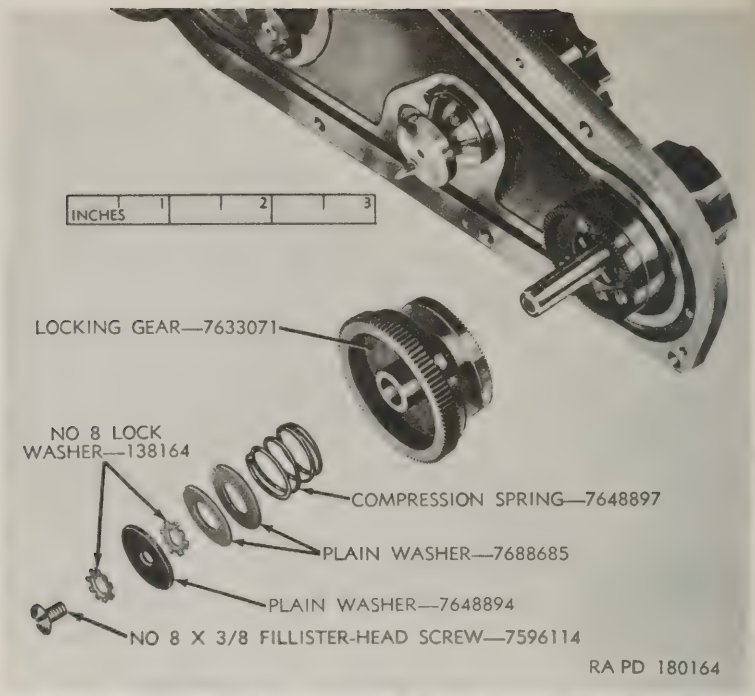


*Figure 225. Ammo knob and related parts—partially exploded view.*

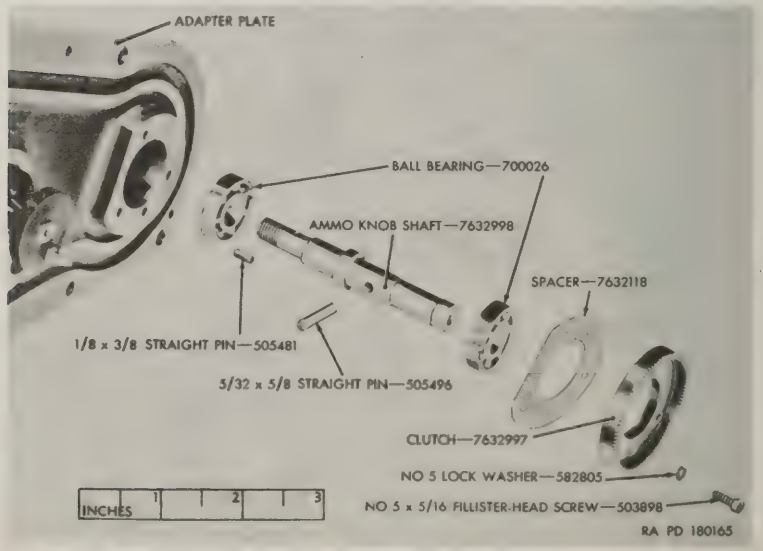


*Figure 226. Ammo knob and related parts—partially exploded view.*

*b. Removal of Elevation and Azimuth Knobs and Related Parts.*

(1) Remove the flat-point set screw (fig. 227) and drive the taper pin from the drive adapter. Slide the drive adapter from the shaft. Pull the drive pin from the adapter.

(2) Slide the locking band from the pivot screw and from around the shaft. Unscrew the pivot screw from the plate and slide the locking cam from the plate.

(3) Slide the elevation and azimuth shafts (figs. 228 and 229) with attached parts from the plate.

(4) Slide the scale from the knob and the compression spring and the ball with fall free.

(5) Remove the cup-point set screws from the elevation and azimuth knobs and pull the knobs from the shafts.

(6) Pick the stop ring from the recess in the adapter ring, unscrew the three fillister-head screws from the stop and the adapter ring, and pull the adapter ring and straight pin from the plate.

*c. Removal of Rheostat and Stereo Scale Knobs.*

(1) Remove one flat-point set screw (fig. 230), and drive one taper pin from each knob. Pull the knobs from the plate.

(2) Remove four set screws from the injection sealing ports in the plate.

(3) Unsolder the wires (fig. 231) from the rotary switch and from the rheostat.

(4) Unscrew the two fillister-head screws (fig. 232) and washers that secure the switch to the plate. Pull the switch from the plate.

(5) Unscrew the four flat-head screws that secure the strap to the plate and pull the strap and the rheostat from the plate.

(6) Drive the taper pin from the shaft, pull the shaft from the rheostat, and unscrew the nut from the rheostat.

(7) Clean the sealing compound from the plate (par. 63) and use a brass wire inserted in the injection ports to clean the compound from the ports.

## 209. Disassembly of Filter Lever Assembly

*a.* Drive the taper pin (fig. 233) from the filter lever (par. 59*a*) and pull the lever from the shaft.

*b.* Tap out the key from the shaft, slide the shaft with compression spring, plunger, and stop as a unit, from the adapter. Slide the plunger and the spring from the shaft.

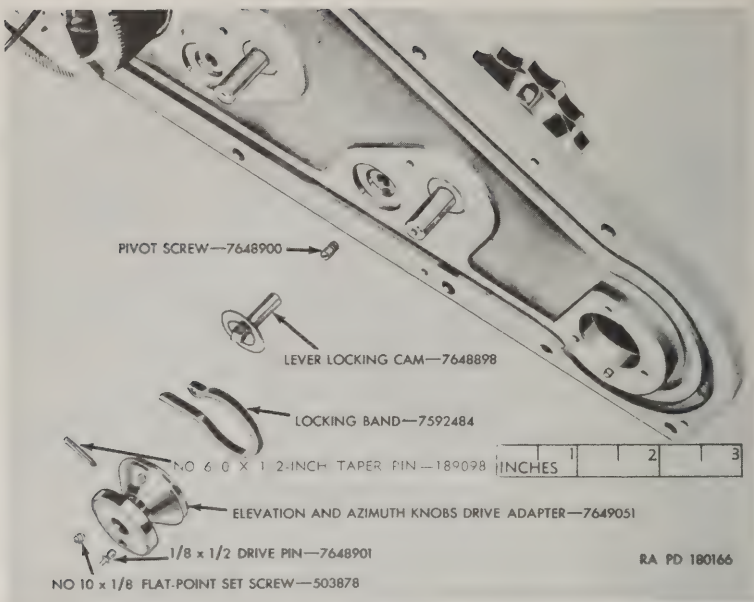
PIVOT SCREW—7648900
LEVER LOCKING CAM—7648898
LOCKING BAND—7592484
NO 6 0 X 1 2-INCH TAPER PIN—189098
INCHES 1 2 3
ELEVATION AND AZIMUTH KNOBS DRIVE ADAPTER—7649051
1/8 x 1/2 DRIVE PIN—7648901
NO 10 x 1/8 FLAT-POINT SET SCREW—503878
RA PD 180166

*Figure 227. Elevation and azimuth knobs and related parts—partially exploded view.*

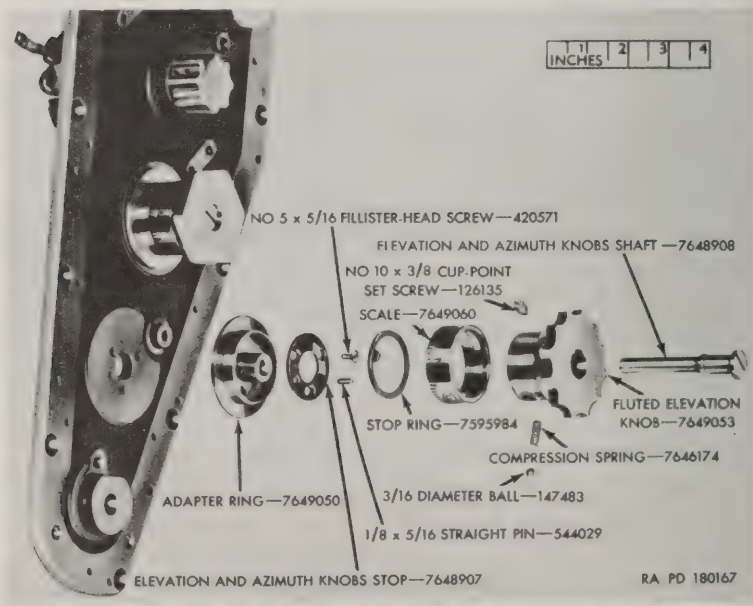


*Figure 228. Elevation knob and related parts—partially exploded view.*

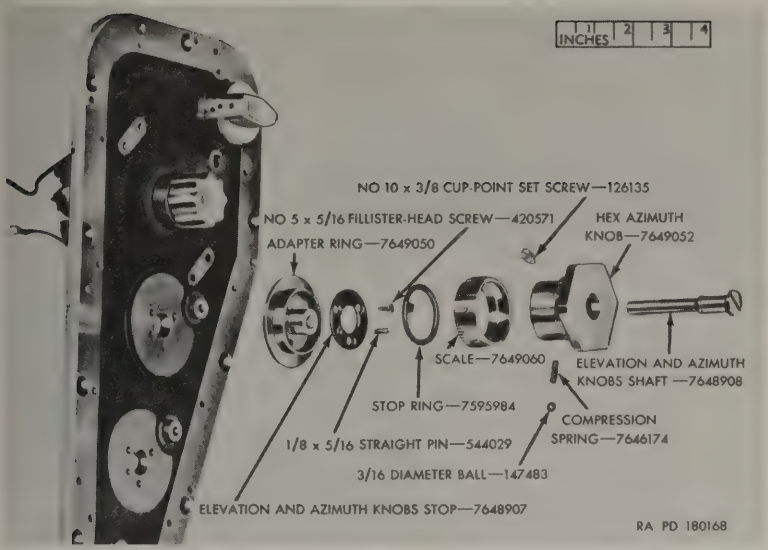


*Figure 229. Azimuth knob and related parts—partially exploded view.*

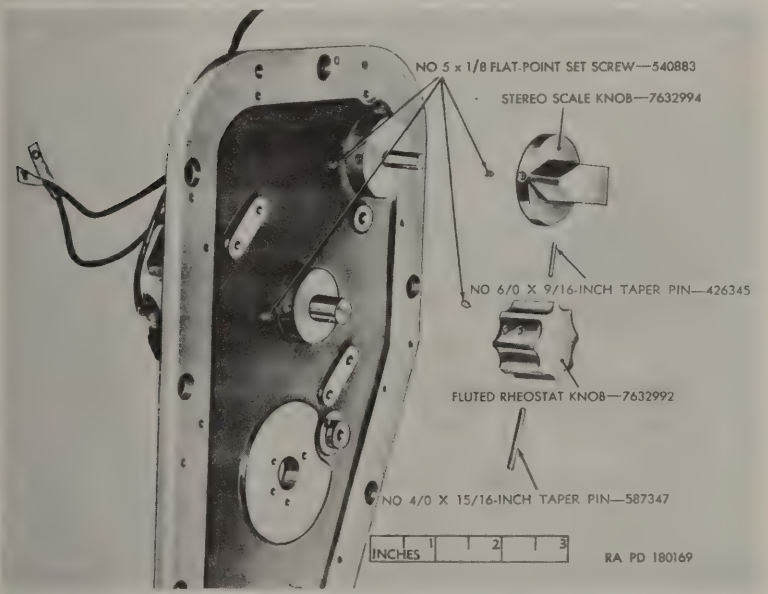
NO 5 x 1/8 FLAT-POINT SET SCREW—540883
STEREO SCALE KNOB—7632994
NO 6/0 X 9/16-INCH TAPER PIN—426345
FLUTED RHEOSTAT KNOB—7632992
NO 4/0 X 15/16-INCH TAPER PIN—587347
INCHES 1 2 3
RA PD 180169

*Figure 230. Rheostat and stereo scale knobs and related parts—partially exploded view.*

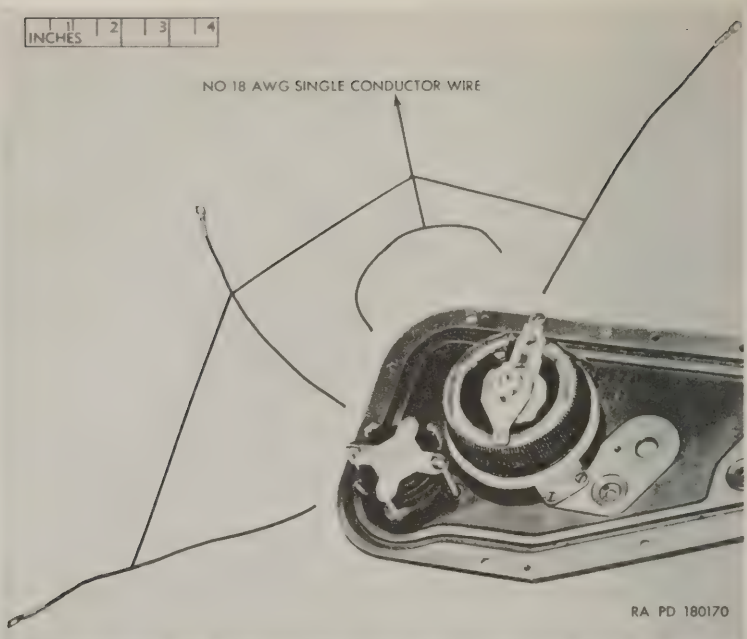


*Figure 231. Rheostat and stereo knobs and related parts—partially exploded view.*

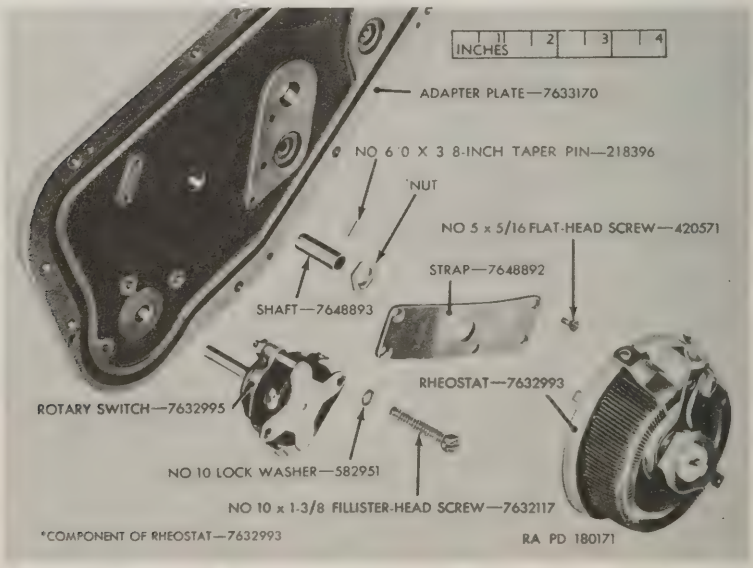


*Figure 232. Rheostat and stereo knobs and related parts—partially exploded view.*

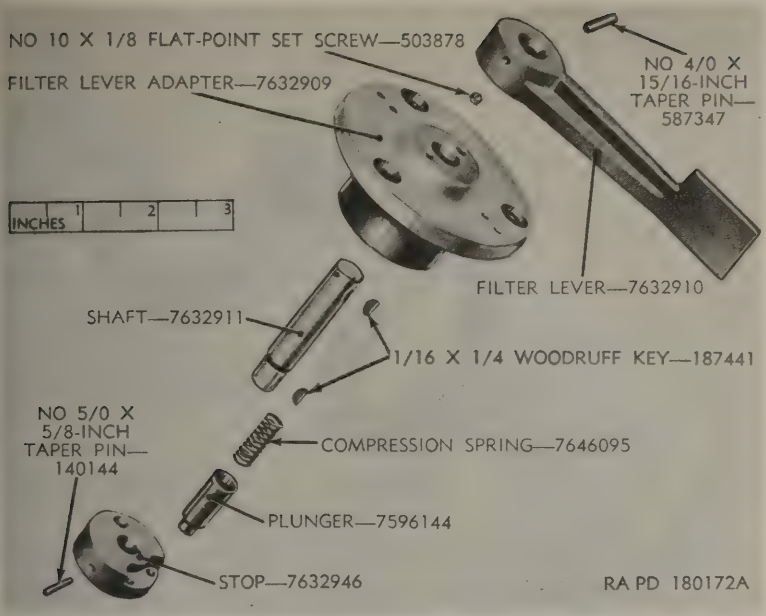


*Figure 233. Filter lever assembly—exploded view.*

*c.* Drive the taper pin from the stop, pull the stop from the shaft, and tap the other key from the shaft.

*d.* Remove the two flat-point set screws from the sealing ports of the adapter and clean the sealing compound from the adapter (par. 63). Insert a brass wire in the sealing ports to clean the compound from the ports.

## 210. Disassembly of Left Bearing Assembly

*a.* Remove the cone-point set screw (fig. 234) from the housing (par. 56). Unscrew the retainer (par. 60) using improvised main bearing wrench 7662086 (fig. 50).

*b.* Remove the felt seal from the retainer, tap the ball bearing from the housing, and remove the other seal from the housing.

## 211. Disassembly of Sealing Window Cell Assembly

*a.* Unscrew the retaining ring (fig. 235) from the cell (par. 60) using tubular wrench 41–W–3726–285 and remove the window from the cell (par. 61*b*). Some difficulty may be experienced in removing the window due to adhesion to the sealing compound. It may be necessary to break the seal by inserting a thin blade between the cell and the window.

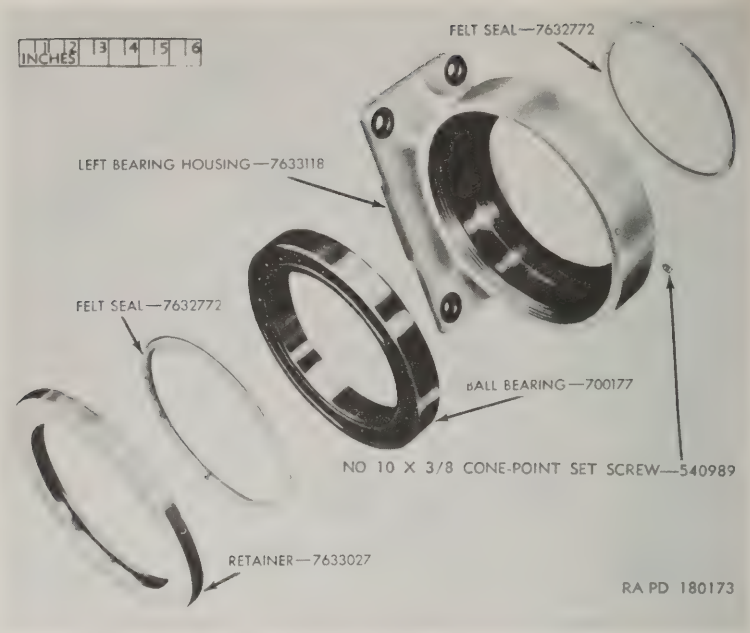


*Figure 234. Left bearing assembly—exploded view.*

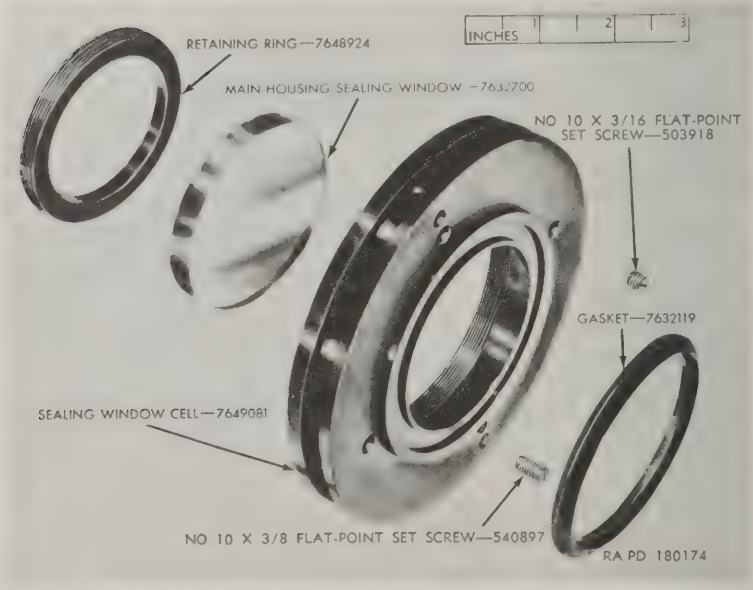


*Figure 235. Sealing window cell assembly—exploded view.*

*b.* Remove the six set screws from the sealing ports (par. 56) in the cell. Pull the gasket from the cell and clean the cement from the gasket and the cell (par. 63).

*c.* Clean the sealing compound from the window and the cell and properly identify the window for reassembly (par. 61*d*).

## 212. Disassembly of Right Bearing Assembly

*a.* Unscrew the fillister-head screw (fig. 236) from the bearing housing and pull the bearing pawl from the housing.

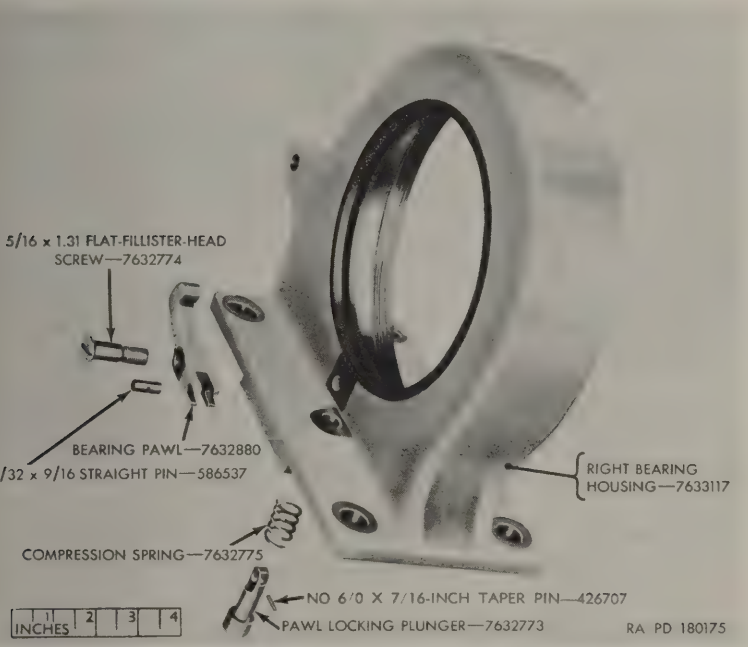


*Figure 236. Right bearing assembly—partially exploded view.*

*b.* Drive the taper pin from the locking plunger (par. 59*a*) and pull the plunger and the compression spring from the housing.

*c.* Pull the straight pin from the housing.

*d.* Complete disassembly by following the procedure as outlined in paragraph 210 (fig. 237).

## 213. Disassembly of Right Penta Reflector Assembly

*a.* Unscrew the fillister-head screw (fig. 238) from the reflector bracket and withdraw it through the penta reflector. Lift the spherical washer from the reflector.

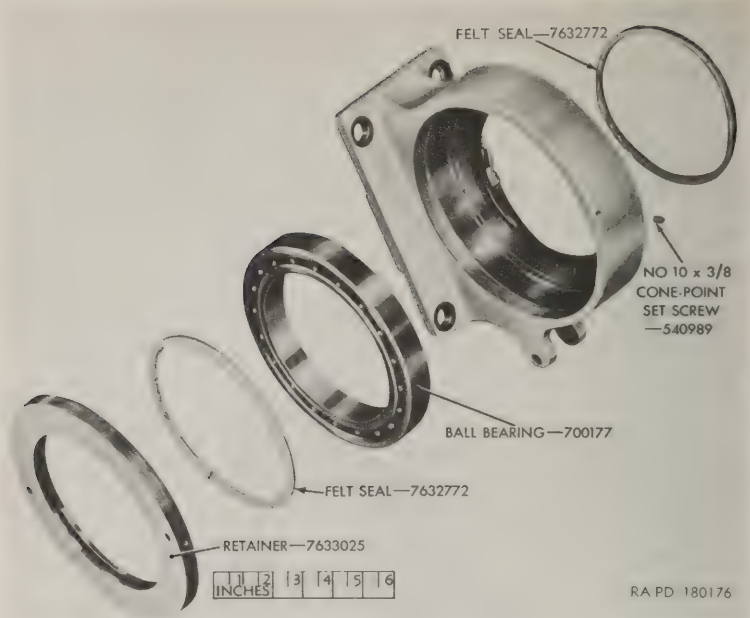


*Figure 237. Right bearing assembly—partially exploded view.*

*b.* Remove the flat-point set screw from the bracket (par. 56), drive the straight pin from the bracket, and remove the reflector. Lift the compression spring from the bracket.

## 214. Disassembly of Left Penta Reflector Assembly

Follow the same procedure as in paragraph 213 (fig. 239).

## 215. Disassembly of Filter Shaft Assembly

Drive the two taper pins (fig. 240) from the two couplings (par. 59*a*), pull the couplings from the shaft, and slide the shaft support from the shaft.

## 216. Disassembly of Compensator Assembly

*a.* Remove the cone-point set screw (fig. 241) and unscrew the retaining ring from the holder (par. 60) using tubular wrench 41–W–3726–195. Remove the filter (par. 61*b*) and clean the sealing compound from the filter, the holder, and the ring (par. 63).

*b.* Remove the cone-point and flat-point set screws (fig. 242) from the housing. Unscrew the retaining ring from the housing (par. 60), using tubular wrench 41–W–3726–195.

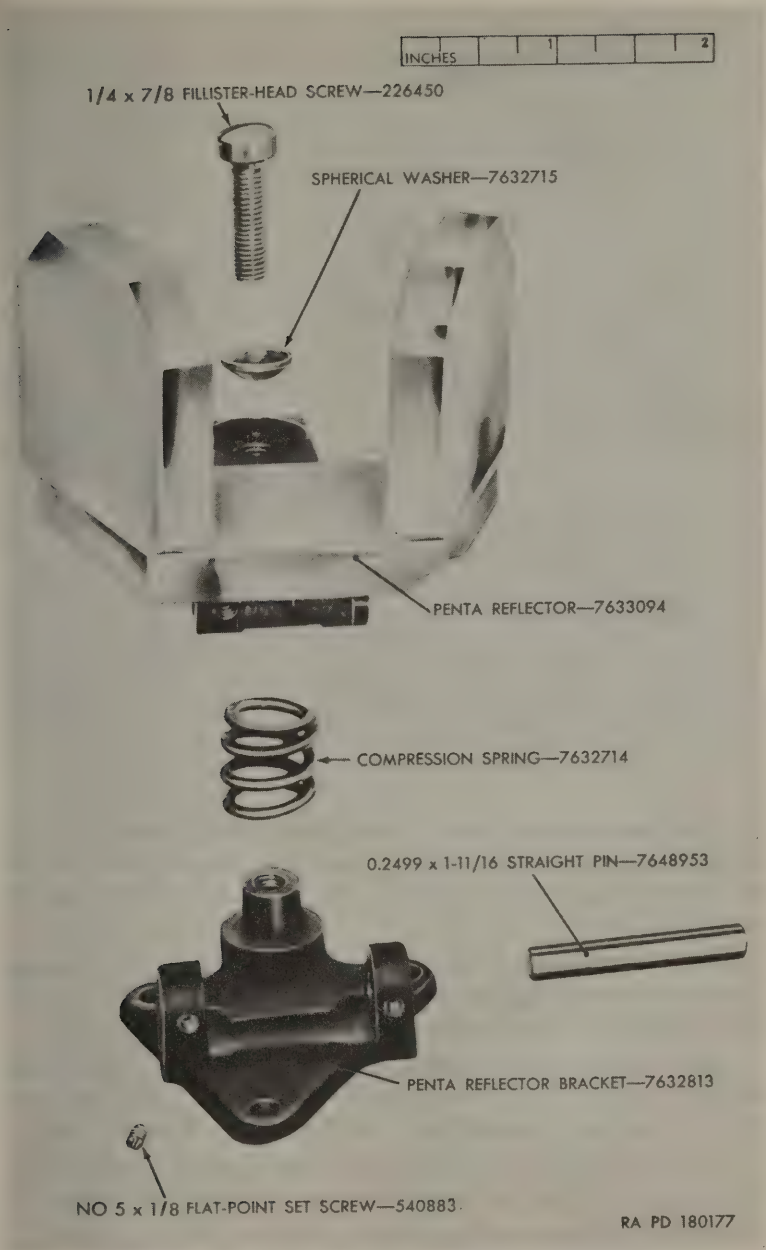


*Figure 238. Right penta reflector assembly—exploded view.*

*Figure 239. Left penta reflector assembly—exploded view.*

*c.* The lens is bonded to the housing with sealing compound. Remove the lens (par. 61*b*) and clean the sealing compound from the lens and the housing. Mark the lens (par. 61*d*) for identification in reassembly.

*d.* Remove the cone-point set screw (fig. 243) from the housing. Unscrew the retaining ring from the housing using tubular wrench 41–W–3726–40. Drive the taper pin from the pinion (par. 59*a*).

*e.* Drive the shaft with bearing from the housing by tapping the shaft at the gear end to disengage the two pinions. Lift the bevel pinion from the housing and slide the ball bearing from the shaft.

*f.* Compress the retaining snap ring using snap ring pliers, lift the ring from the housing, and tap the ball bearing from the housing.

*g.* Drive the taper pin (fig. 244) from the coupling and pull the coupling from the shaft.

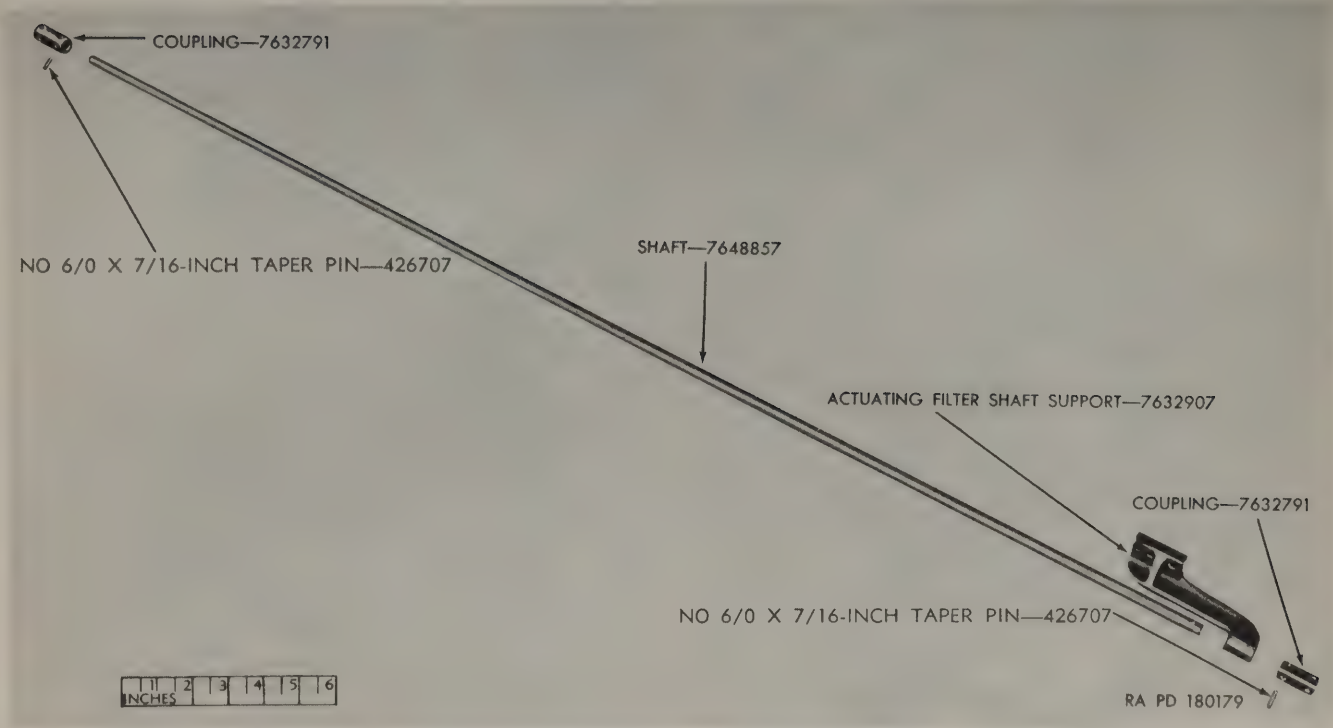


*Figure 240. Filter shaft assembly—exploded view.*

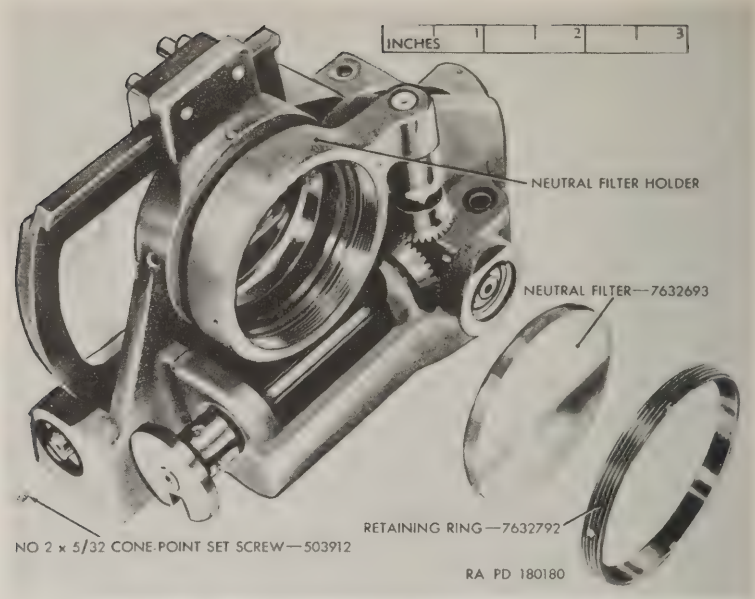


*Figure 241. Compensator assembly—partially exploded view.*

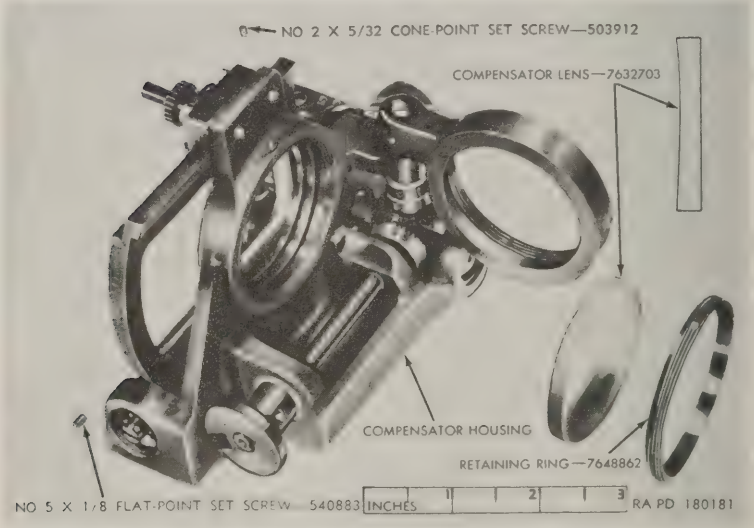


*Figure 242. Compensator assembly—partially exploded view.*

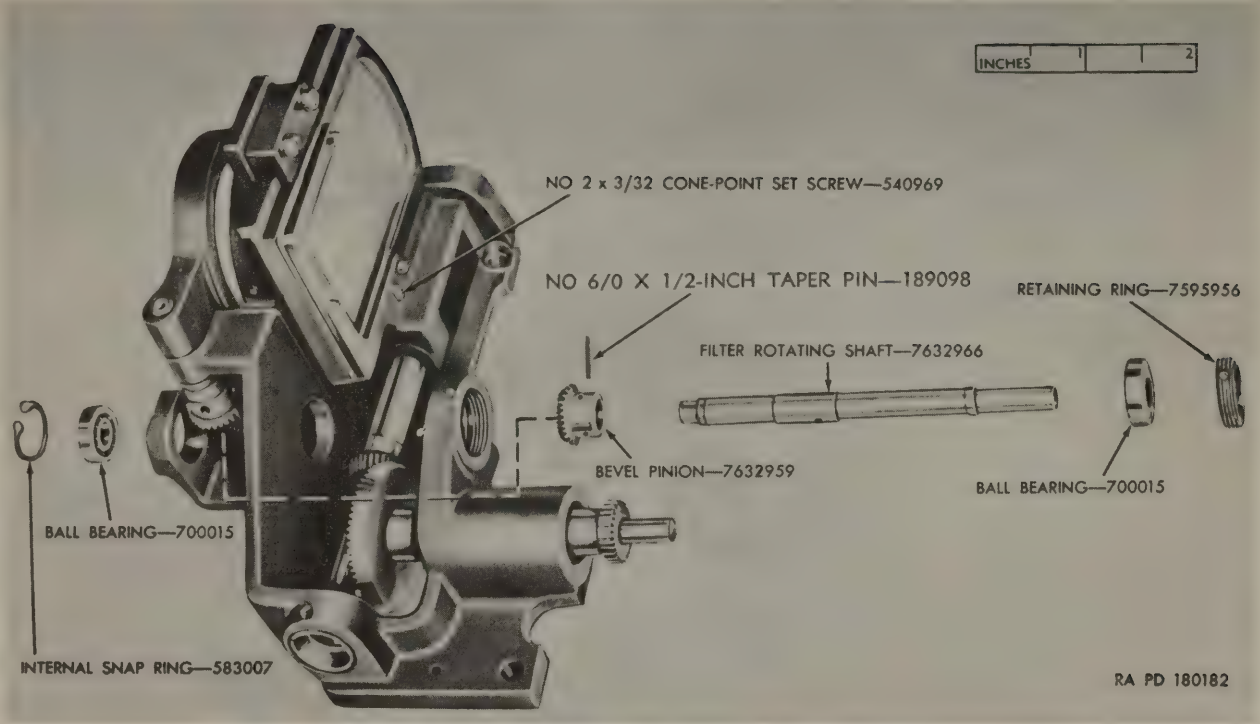


*Figure 243. Compensator assembly—partially exploded view.*

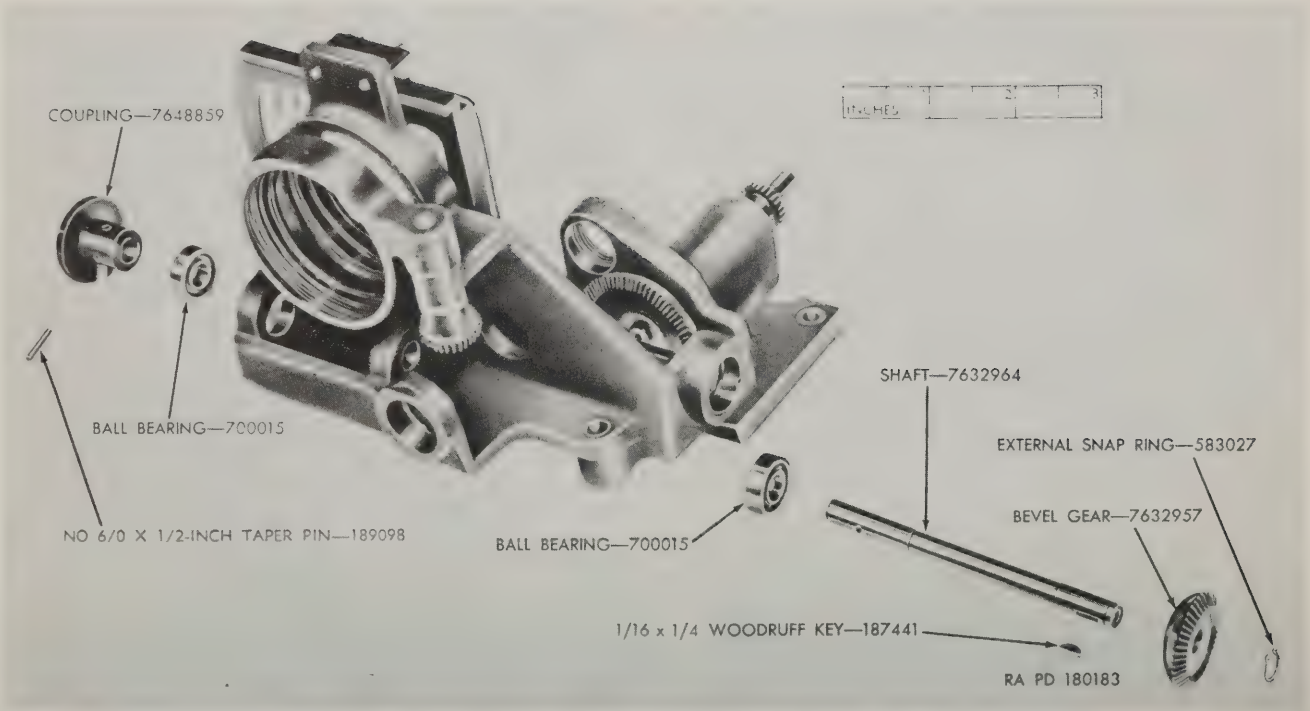


*Figure 244. Compensator assembly—partially exploded view.*

*h.* Drive the taper pin from the bevel pinion (fig. 245), raise the pinion until it is disengaged from the bevel gear (fig. 244). Tap the coupling end of the shaft and drive the shaft with the bevel gear from the housing.

*i.* Tap the two ball bearings from the housing (fig. 244). Compress the retaining snap ring with snap ring pliers, slide the ring from the shaft, pull the bevel gear from the shaft, and tap the key from the shaft.

*j.* Drive the taper pin (fig. 245) from the holder, pull the holder from the shaft, slide off the two plain and one spring washer from the shaft, and slide the shaft with the pinion from the housing.

*k.* Pull the pinion from the shaft.

*Note.*—The taper pin was punched from the pinion and the pinion raised to remove the bevel gear as outlined in *h* above.

*l.* Drive the taper pin (fig. 246) from the spur pinion and pull the pinion from the shaft. Remove the cone-point set screw from the housing and unscrew the retaining ring from the housing using an improvised 5/8-inch tubular wrench (fig. 57).

*m.* Drive the taper pin from the bevel gear, drive the shaft with the two ball bearings and key from the gear and housing. The gear will fall free when the shaft is withdrawn.

*n.* Tap the key from the shaft and slide the two ball bearings from the shaft.

*o.* Unscrew the two fillister-head screws (fig. 247) and two lock-washers that secure the guide to the housing and pull the guide from the housing.

*p.* Remove the cone-point set screw (fig. 248) from the housing. Unscrew the retaining ring from the housing, using tubular wrench 41–W–3726–40. Tap the slotted end of the holder assembly to drive out the ball bearing.

*q.* Continue to slide the holder assembly until the slotted end clears the housing; then raise the holder assembly at an angle until the other end clears the housing.

*r.* Drive the taper pin from the bevel pinion and pull the pinion from the holder assembly. Compress and remove the snap ring and tap the ball bearing from the housing.

*s.* Unscrew the three fillister-head screws (fig. 249) and lock washers that secure the retainer and gasket to the holder. The gasket is cemented to the retainer and may be damaged in prying it from the retainer. Clean the cement from the gasket and retainer (par. 63).

*t.* Push the lens from the holder and properly identify it for reassembly (par. 61*d*).

*u.* Unscrew the screw (fig. 250) from the holder.

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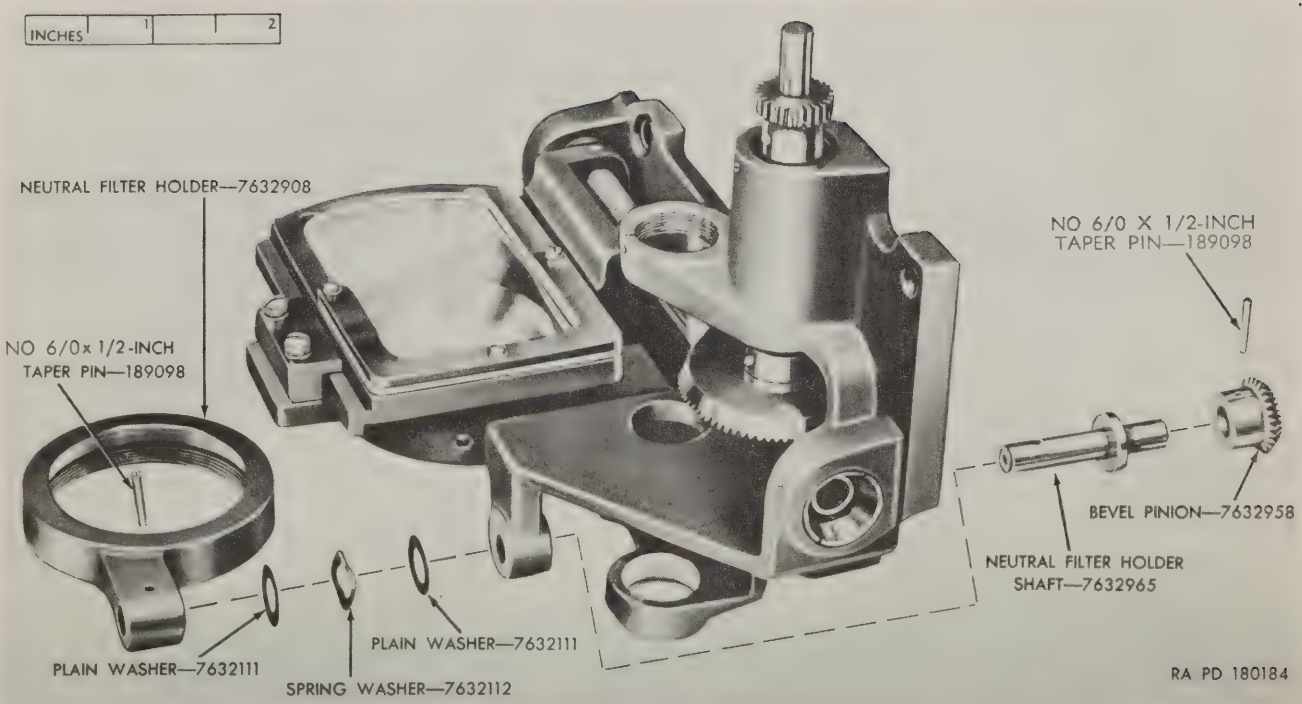


*Figure 245. Compensator assembly—partially exploded view.*

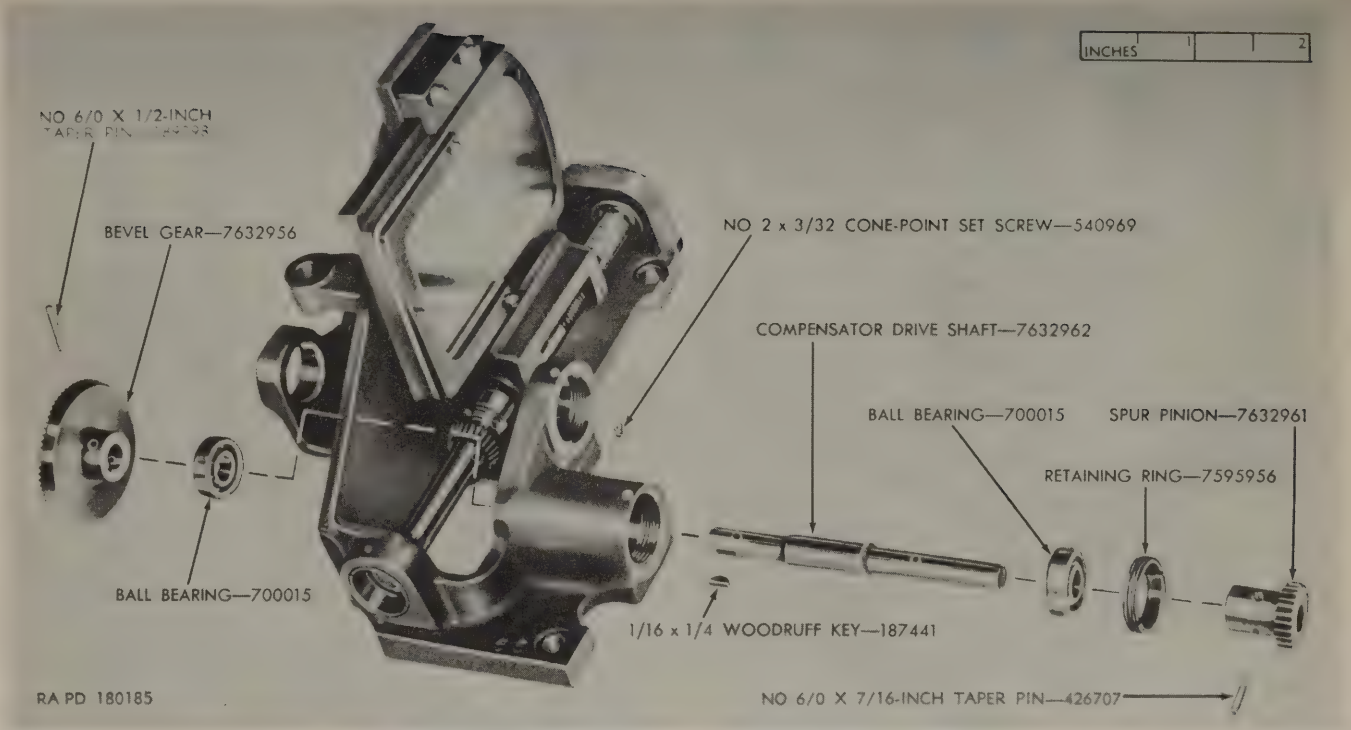


*Figure 246. Compensator assembly—partially exploded view.*

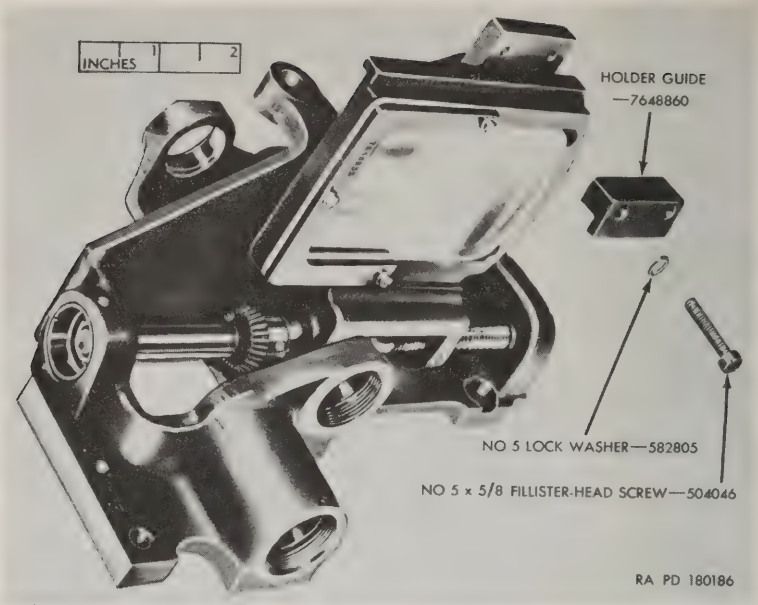


*Figure 247. Compensator assembly—partially exploded view.*

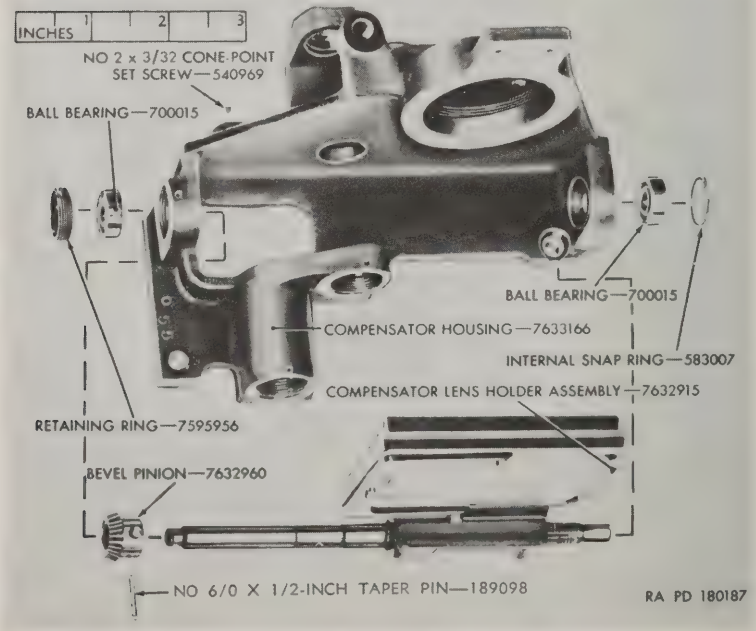


*Figure 248. Compensator assembly—partially exploded view.*

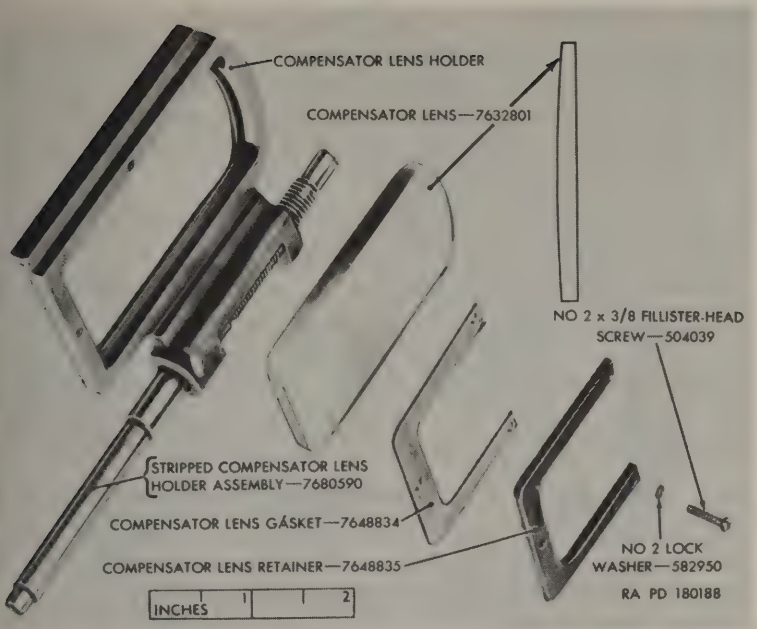


*Figure 249. Compensator assembly—partially exploded view.*

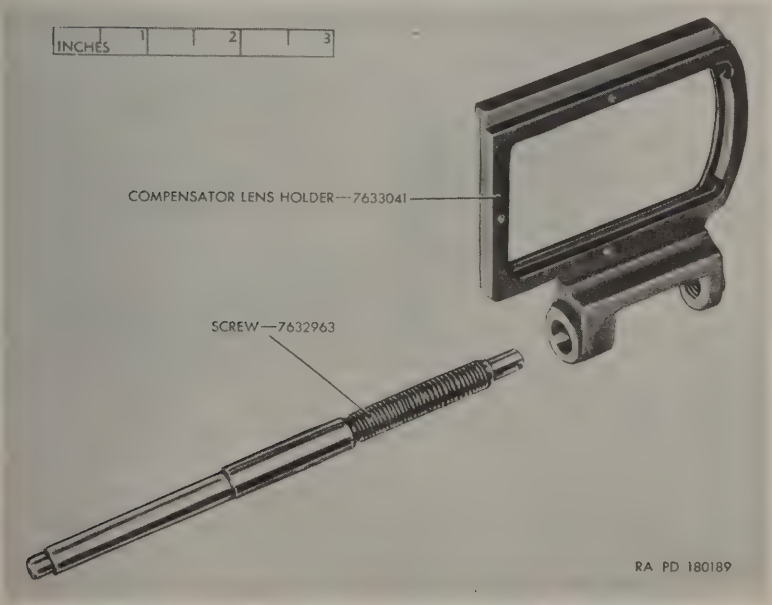


*Figure 250. Compensator assembly—partially exploded view.*

## 217. Disassembly of Neutral Filter Assembly

*a.* Remove the cone-point set screw (fig. 251) from the filter holder (par. 56). Unscrew the retaining ring from the holder using tubular wrench 41–W–3726–195. Carefully press the filter from the holder.

*b.* Drive taper pin (fig. 252) from the holder and slide the holder, two plain, and one spring washer from the shaft.

*c.* Drive one taper pin from the collar and one from the miter gear and tap the shaft from the housing.

*d.* Remove the cone-point set screw (fig. 253) from the housing and unscrew the retaining ring from the housing, using improvised 5/8-inch tubular wrench (fig. 57). Drive the taper pin from the gear, pull the gear from the shaft, and tap the shaft and a ball bearing from the housing. Slide the ball bearing from the shaft and tap the other ball bearing from the housing.

## 218. Disassembly of Superelevation Mechanism Assembly

*a.* Unscrew the two fillister-head screws (fig. 254) and lock washers that secure the upper bracket to the lower bracket. Separate the brackets and drive the two straight pins from the upper bracket.

*b.* Disassemble the upper bracket assembly as described in (1) through (5) below.

(1) Unscrew the five screws (fig. 255) and washers from the transmitter to disconnect the five wire terminals from the transmitter.

(2) Unscrew the three fillister-head screws and lock washers that secure the three mounting clamps to the bracket. Pull the transmitter from the bracket.

(3) Unscrew the slotted round nut from the transmitter and slide off the spur gear, the washer, and the spacer from the transmitter.

(4) Unsolder the five wires from the plug, unwind three pieces of tape, and pull off two markers from each wire.

(5) Unscrew the two hex nuts (fig. 256) from the plug and remove the two lock washers from the bracket. Pull the plug from the bracket.

*c.* Disassemble the lower bracket assembly as described in (1) through (14) below.

(1) Drive the taper pin (fig. 257) from the spur gear and pull the gear from the spider assembly. Remove the cone-point set screw from the bracket and unscrew the retaining ring from the bracket using improvised 5/8-inch tubular wrench (fig. 57).

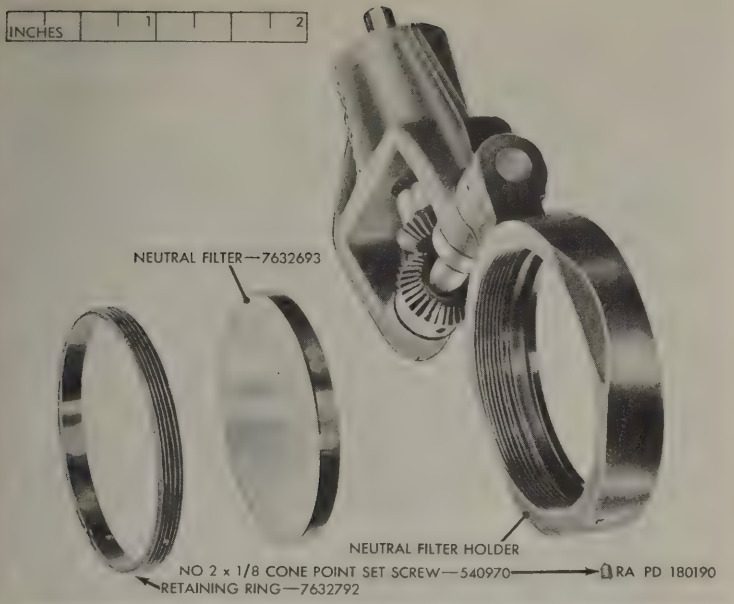


*Figure 251. Neutral filter assembly—partially exploded view.*

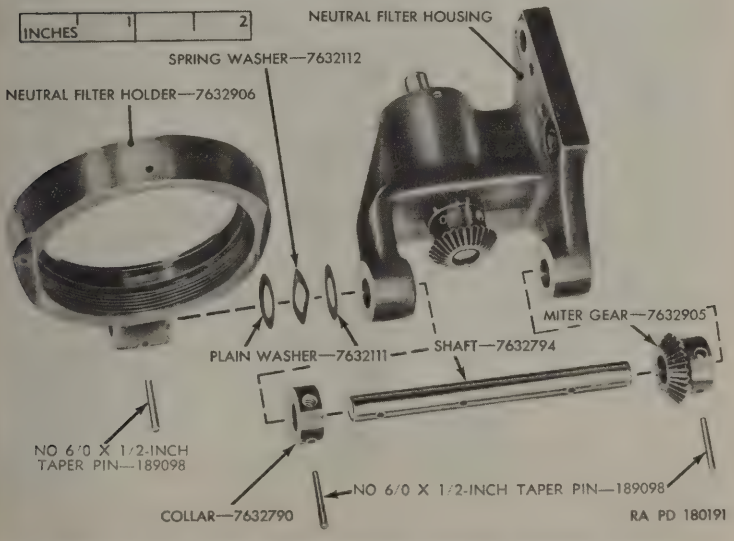


*Figure 252. Neutral filter assembly—partially exploded view.*

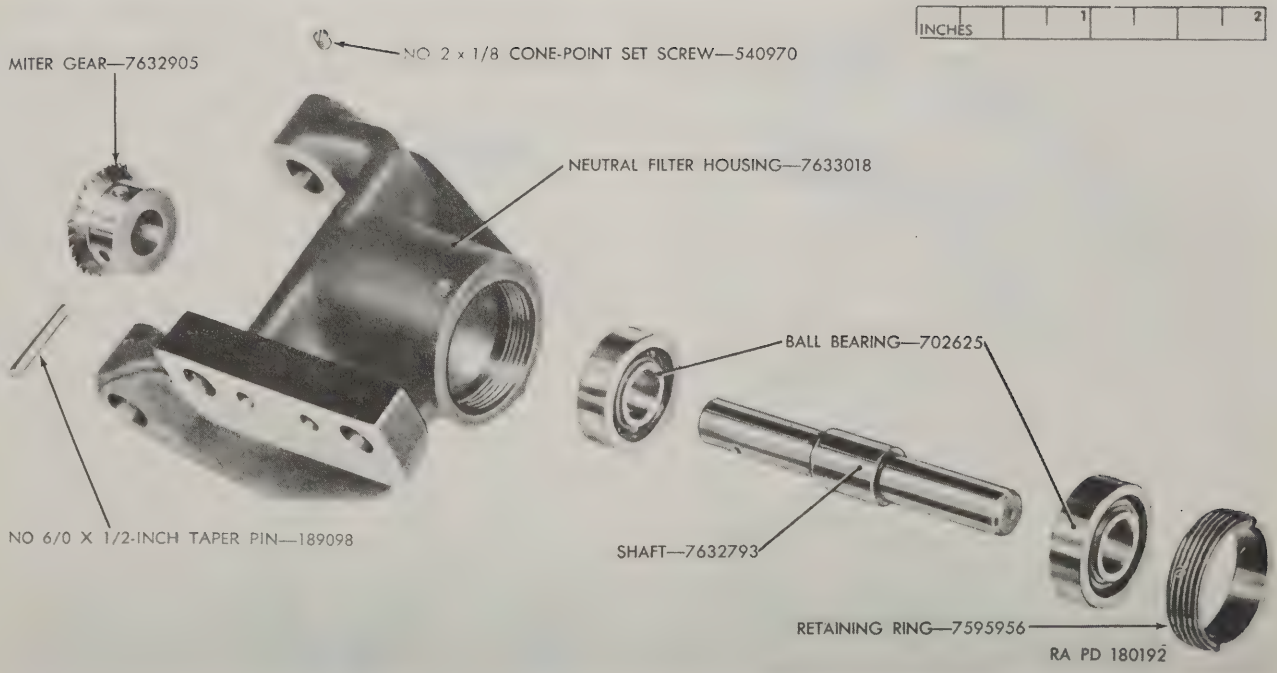


*Figure 253. Neutral filter assembly—partially exploded view.*

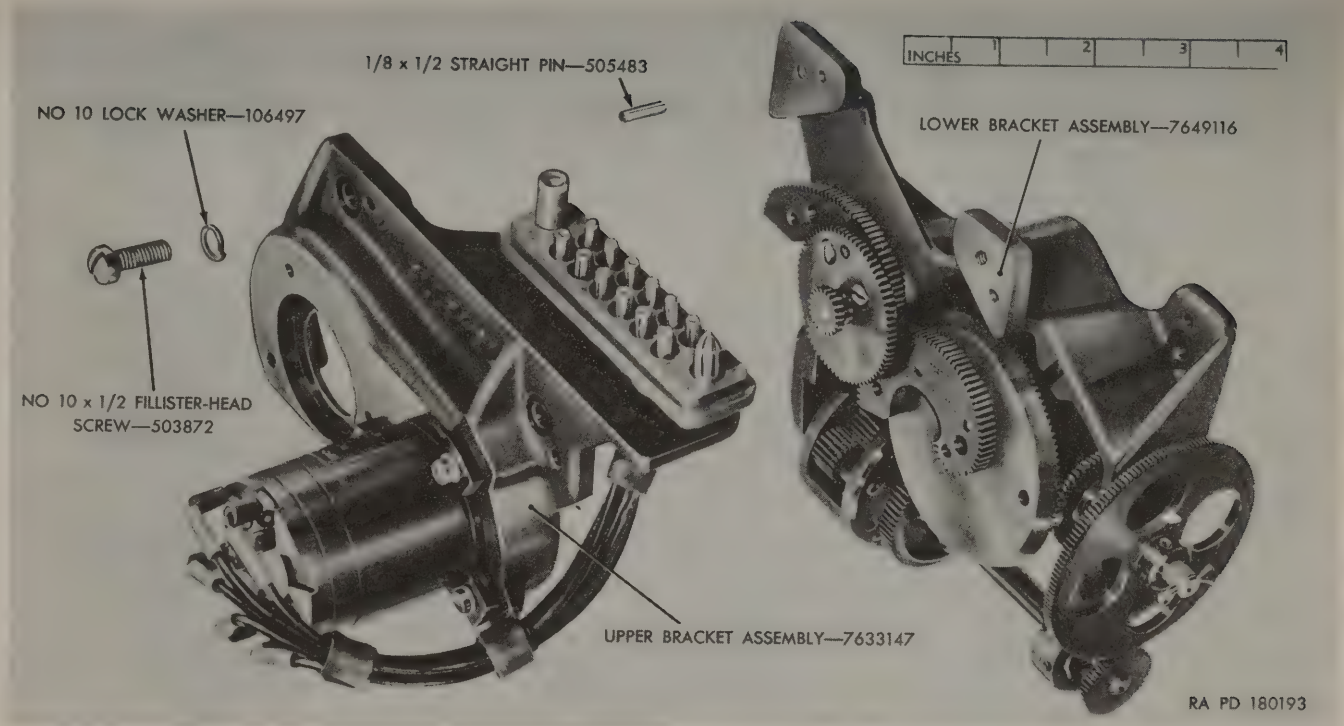


*Figure 254. Superelevation mechanism assembly—partially exploded view.*

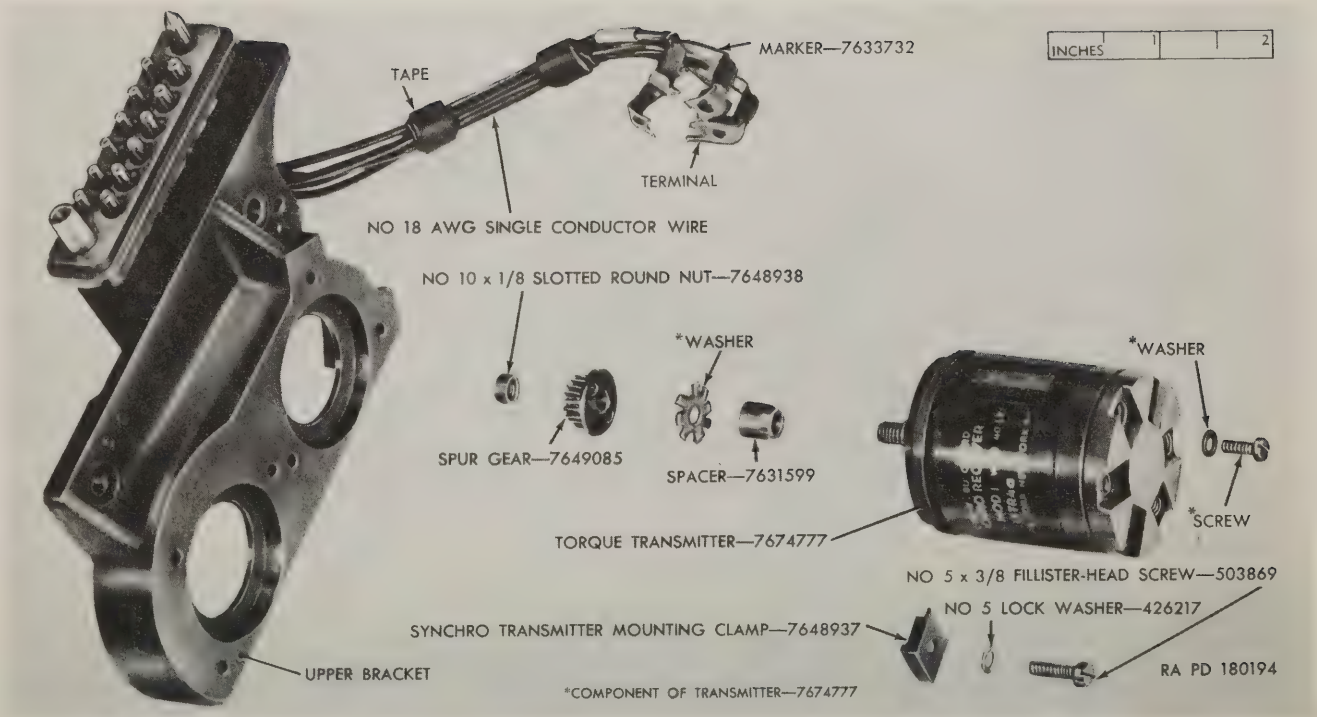


*Figure 255. Upper bracket assembly—partially exploded view.*

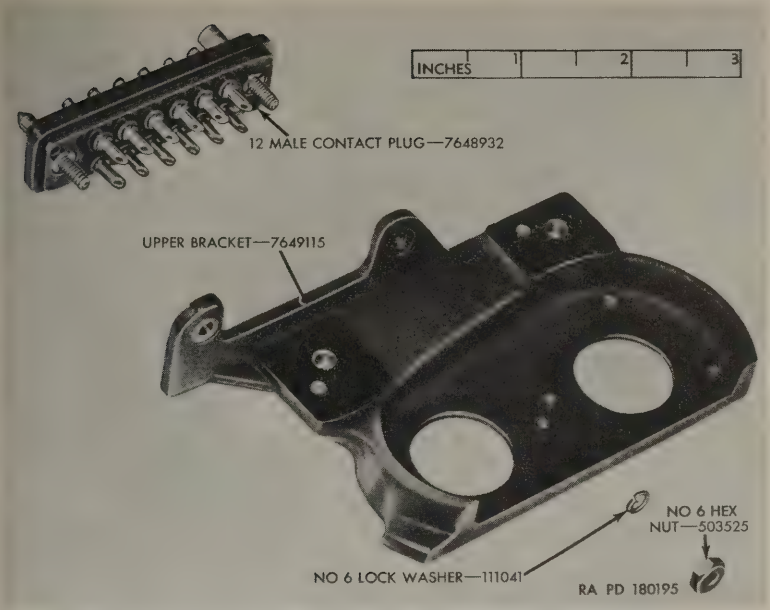


*Figure 256. Upper bracket assembly—partially exploded view.*

(2) Tap the spider assembly to push the right ball bearing from the bracket. This procedure frees the other end of the spider assembly from the bracket and the spider assembly, with the two gears and the collar, can be removed from the bracket.

(3) Tap the other ball bearing from the bracket, compress the retaining snap ring with snap ring pliers, and lift the ring from the bracket.

(4) Drive the taper pin (fig. 258) from the collar, pull the collar and the two spur gears from the spider assembly.

(5) Disassemble the spider assembly as described in (*a*) and (*b*) below.

(*a*) Unscrew the four fillister-head screws (fig. 259) and lock washers that secure the two rings together.

(*b*) Drive the two straight pins from the rings. When the rings are pulled apart, the spider will fall free and the four spur gears can be pulled from the rings.

(6) Drive the taper pin (fig. 260) from the collar. Unscrew the collar from the shaft and slide the shaft with the component gears from the bracket. Tap the two ball bearings from the bracket.

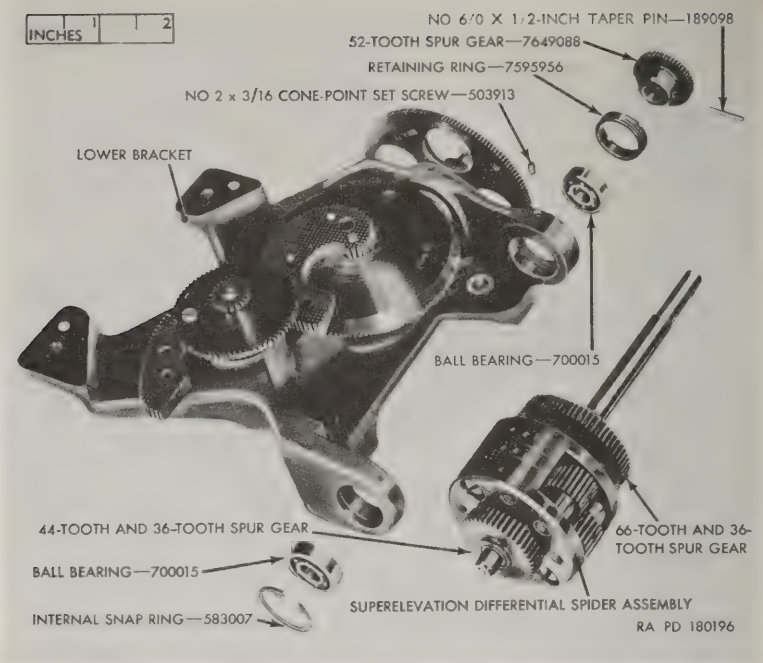


*Figure 257. Lower bracket assembly—partially exploded view.*

(7) Compress the two retaining snap rings with snap ring pliers and lift the rings from the bracket. Drive the taper pin from the spur gear of the component gears and pull the component gears from the shaft.

(8) To disassemble the component gears, unscrew the two fillister-head screws and lock washers from the spur gear, punch out the straight pin, and pull the two gears apart.

(9) Drive the taper pin (fig. 261) from the collar. Unscrew the collar from the shaft and slide the shaft with the component gears from the bracket. Tap out the two ball bearings from the bracket.

(10) Compress the two retaining snap rings with a snap ring pliers and lift the rings from the bracket. Drive the taper pin from the bevel gear and pull the component gears from the shaft.

(11) Disassemble the component gears as outlined in (8) above.

(12) Compress the spread ends of the cotter pin (fig. 262), pull the head with a pliers to remove the pin from the drive shaft. Drive the taper pin from the spur gear and pull the gear from the shaft.

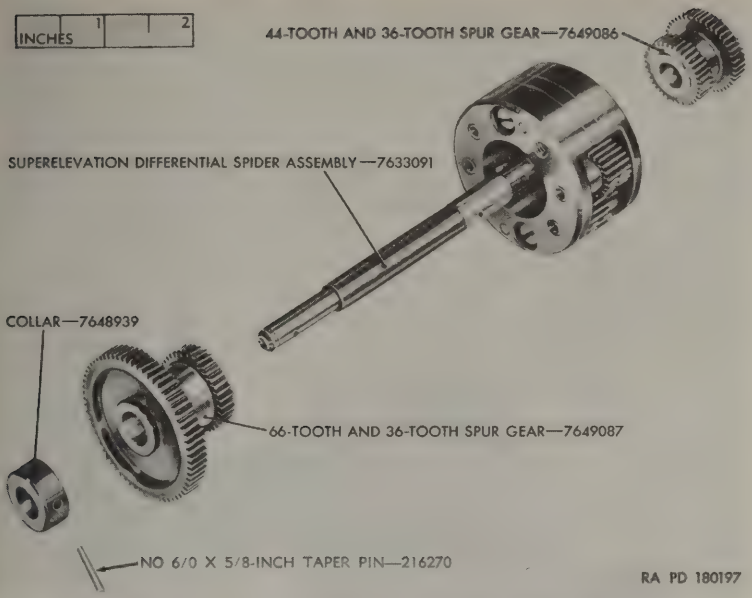


*Figure 258. Spider assembly—partially exploded view.*

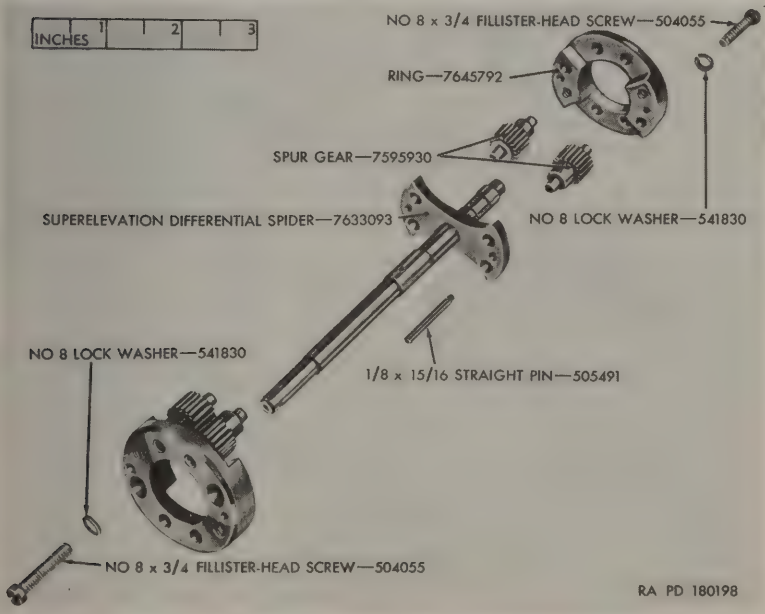


*Figure 259. Spider assembly—partially exploded view.*

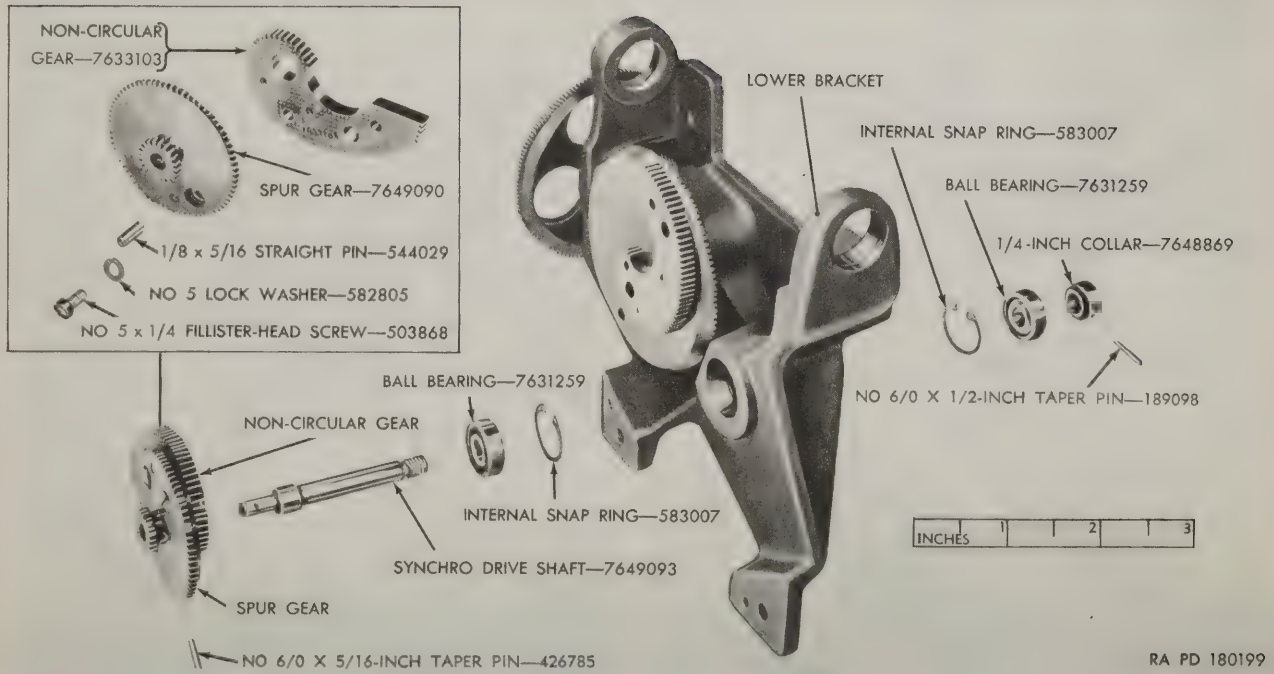


*Figure 260. Lower bracket assembly—partially exploded view.*

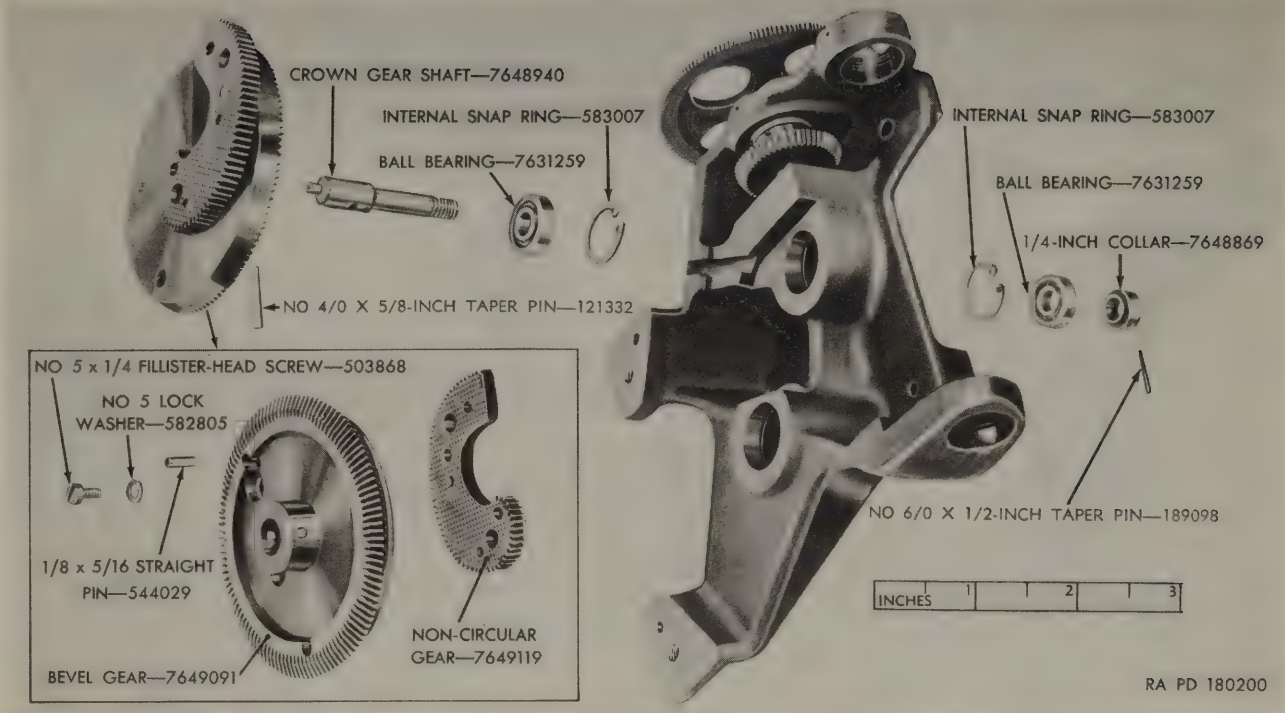


*Figure 261. Lower bracket assembly—partially exploded view.*

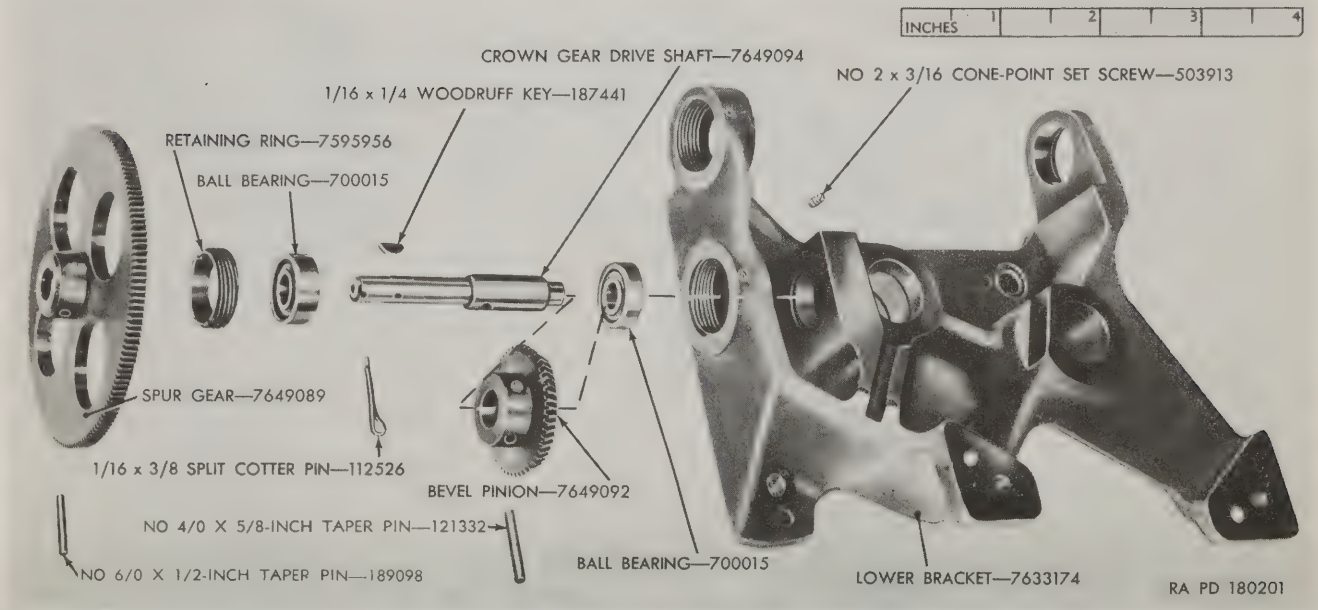


*Figure 262. Lower bracket assembly—partially exploded view.*

(13) Drive the taper pin from the bevel pinion and remove the cone-point set screw from the bracket. Unscrew the retaining ring from the bracket using an improvised 5/8-inch tubular wrench (fig. 57). Tap the key from the shaft.

(14) Pull the shaft with ball bearing from the bracket; the pinion will fall free. Slide the bearing from the shaft and pull the other ball bearing from the bracket.

## 219. Disassembly of Superelevation Differential Assembly

*a.* Drive the taper pin (fig. 263) from the spur pinion (par. 59*a*), pull the pinion from the spider assembly, and tap the key from the spider.

*b.* Unscrew the two fillister-head screws and lock washers from the bracket. Pull the two component parts of the spider bracket apart leaving the spider assembly with the two gears in the smaller bracket.

*c.* Pull the spider assembly from the bracket. Pull the two gears from the spider assembly and tap out the two ball bearings from the brackets.

*d.* Compress the two retaining snap rings with a snap ring pliers and lift the rings from the brackets. Drive the two straight pins from the bracket.

*e.* To disassemble the spider assembly, unscrew the two fillister-head screws (fig. 264) and lock washers from each ring, pull the two rings apart, and the four gears and the spider will fall free.

## 220. Disassembly of Range Shaft Assembly

*a.* Drive the taper pin (fig. 265) from the collar (par. 59*a*). Slide the collar and the left support bracket from the shaft and tap the two ball bearings from the bracket.

*b.* Compress the two snap rings with snap ring pliers and lift rings from the bracket.

*c.* Drive the taper pin (fig. 266) from the spur gear and slide the gear from the shaft. Tap the key from the shaft. Drive the taper pin from the collar and slide the collar from the shaft.

*d.* Drive the taper pin (fig. 267) from the spur gear and slide the gear from the shaft. Tap the key from the shaft and slide the support bracket from the shaft.

*e.* Compress the two outer retaining snap rings with snap ring pliers and lift the rings from the support. Tap the two ball bearings from the support and remove the inner retaining snap rings using snap ring pliers.

*f.* Drive the taper pin (fig. 268) from the bracket. Unscrew the slotted stud that holds the plain washer and the spur gear with its two ball bearings to the bracket.

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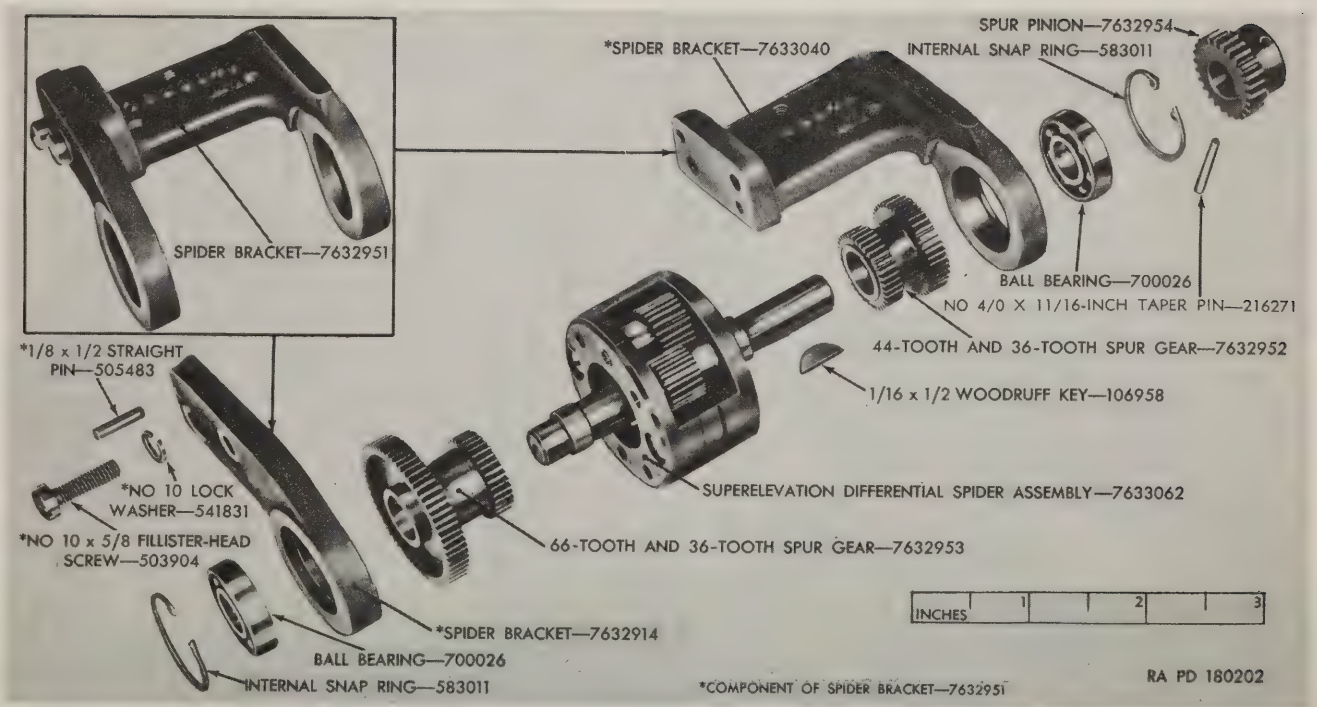


*Figure 263. Superelevation differential assembly—exploded view.*

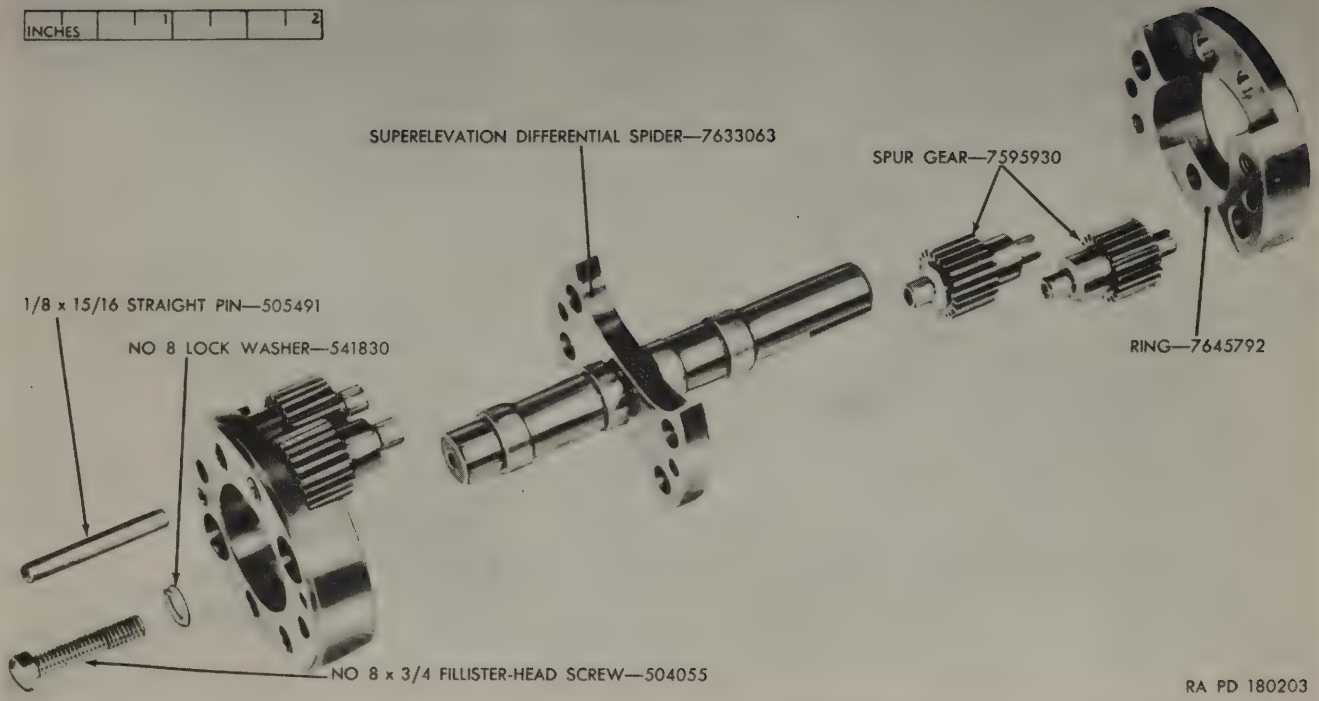


*Figure 264. Spider assembly—exploded view.*

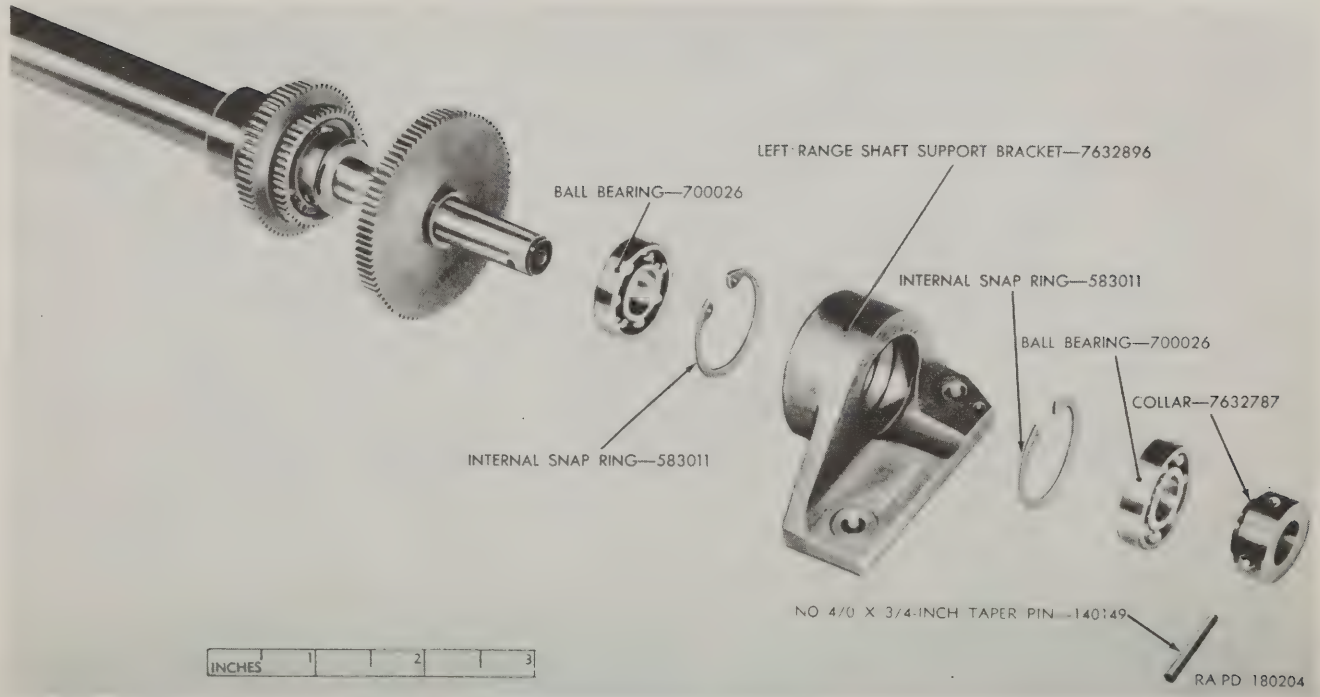


*Figure 265. Range shaft assembly—partially exploded view.*

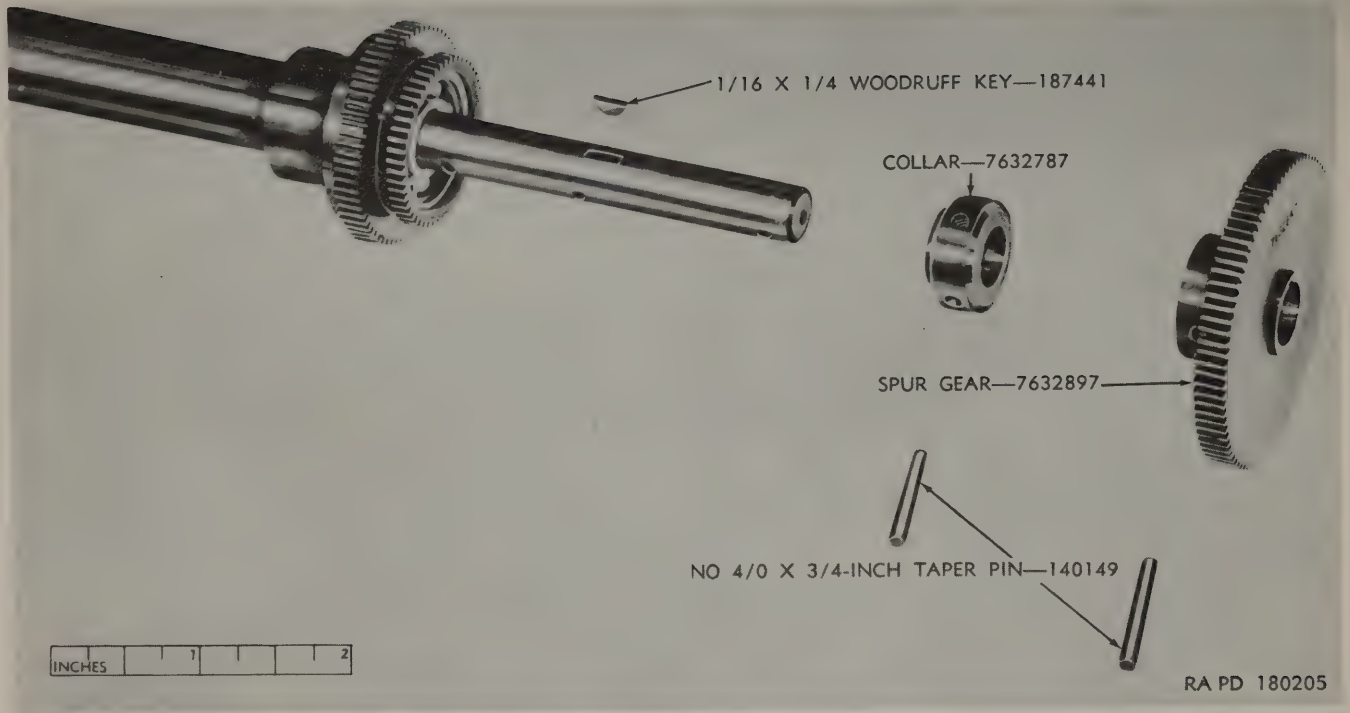


*Figure 266. Range shaft assembly—partially exploded view.*

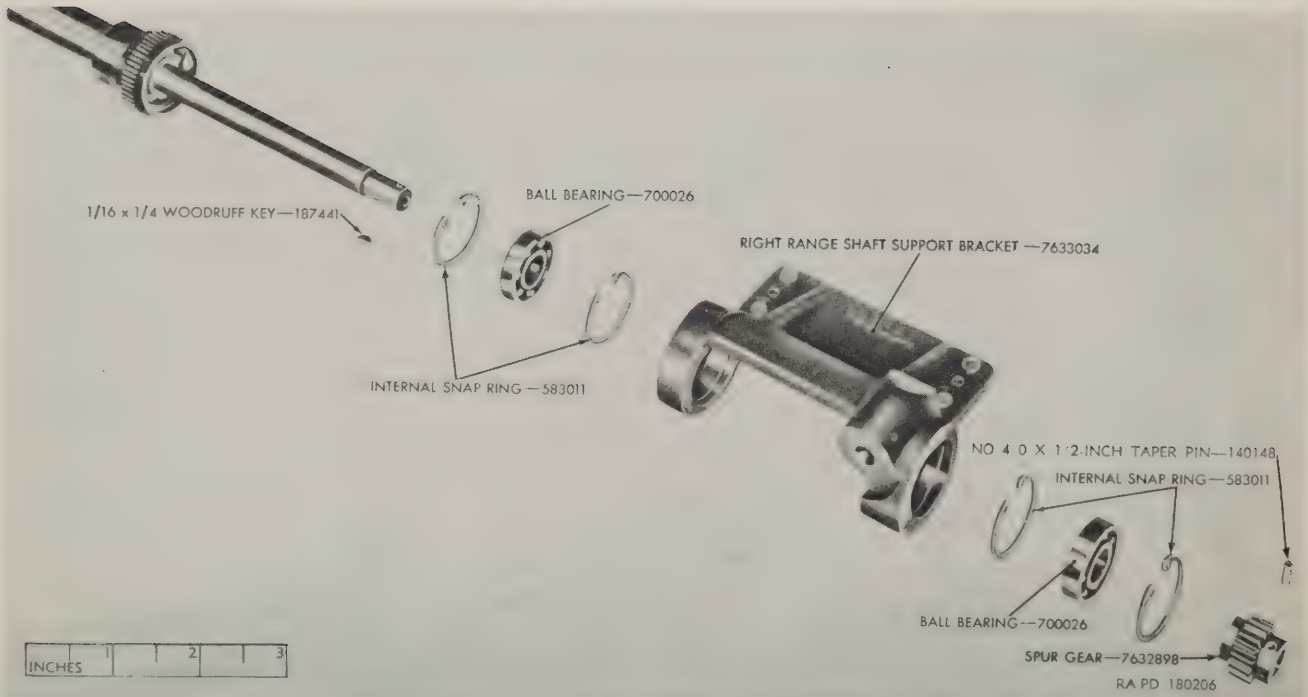


*Figure 267. Range shaft assembly—partially exploded view.*

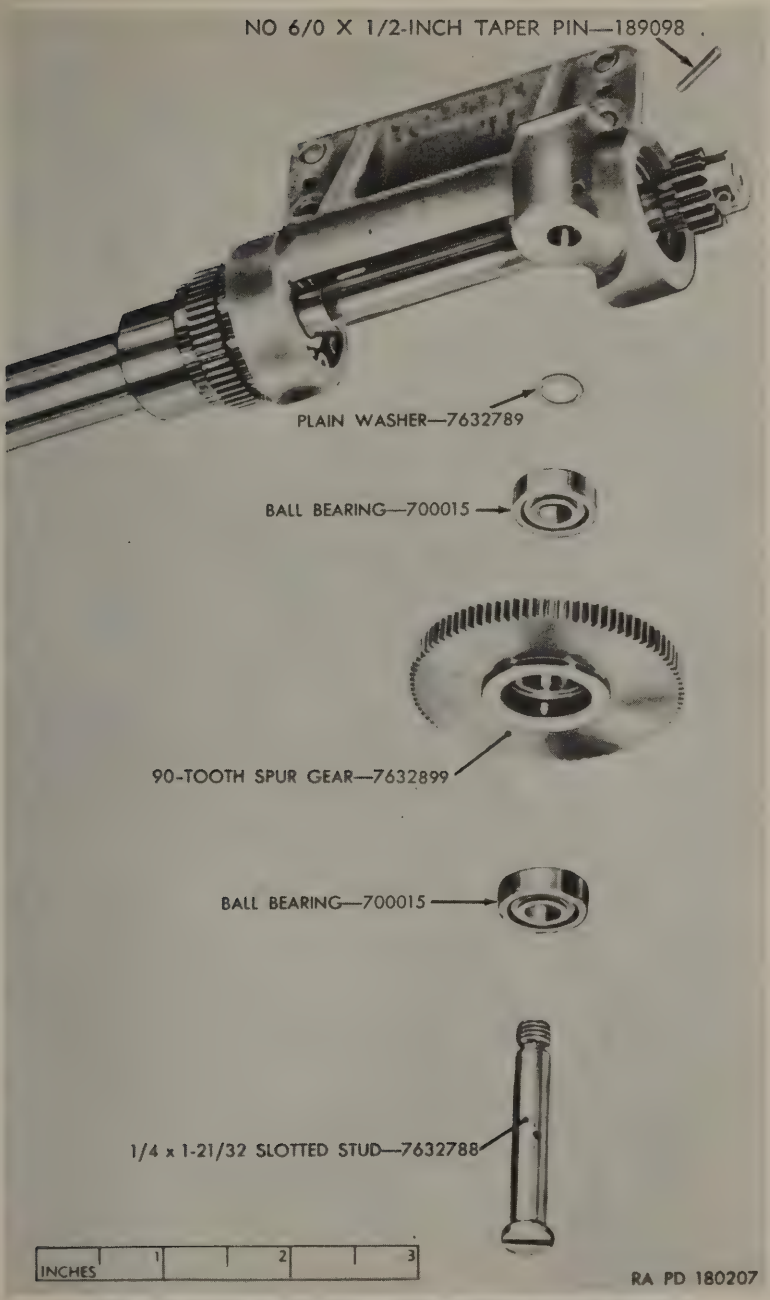


*Figure 268. Range shaft assembly—partially exploded view.*

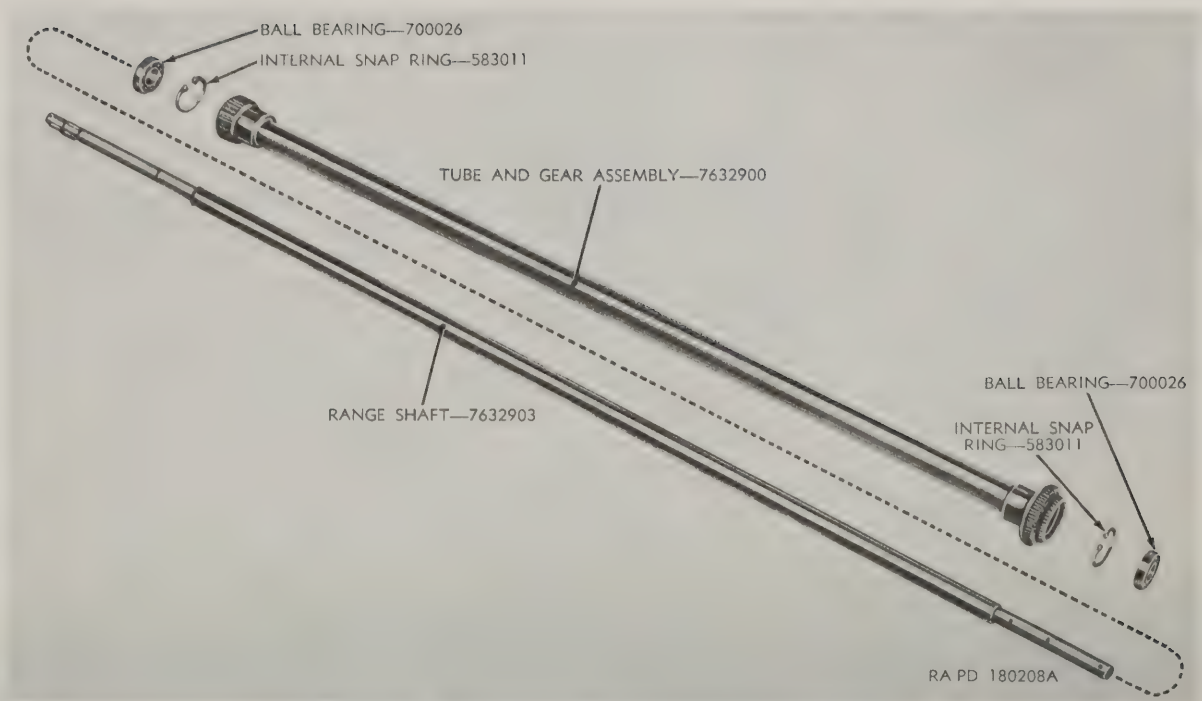


*Figure 269. Range shaft assembly—partially exploded view.*

*g.* Slide the washer and the gear with its two ball bearings from the stud and tap the two ball bearings from the gear.

*h.* Compress the two snap rings (fig. 269) and lift the snap rings from the tube. Push the range shaft from the tube and gear assembly to force the ball bearings from the tube and the gear assembly.

*i.* Slide the shaft from the tube and the gear assembly.

## 221. Disassembly of Ballistic Differential Assembly (T41)

*a.* Drive the taper pin (fig. 270) from the spur pinion (par. 59*a*), pull the pinion from the shaft, and tap the key from the shaft.

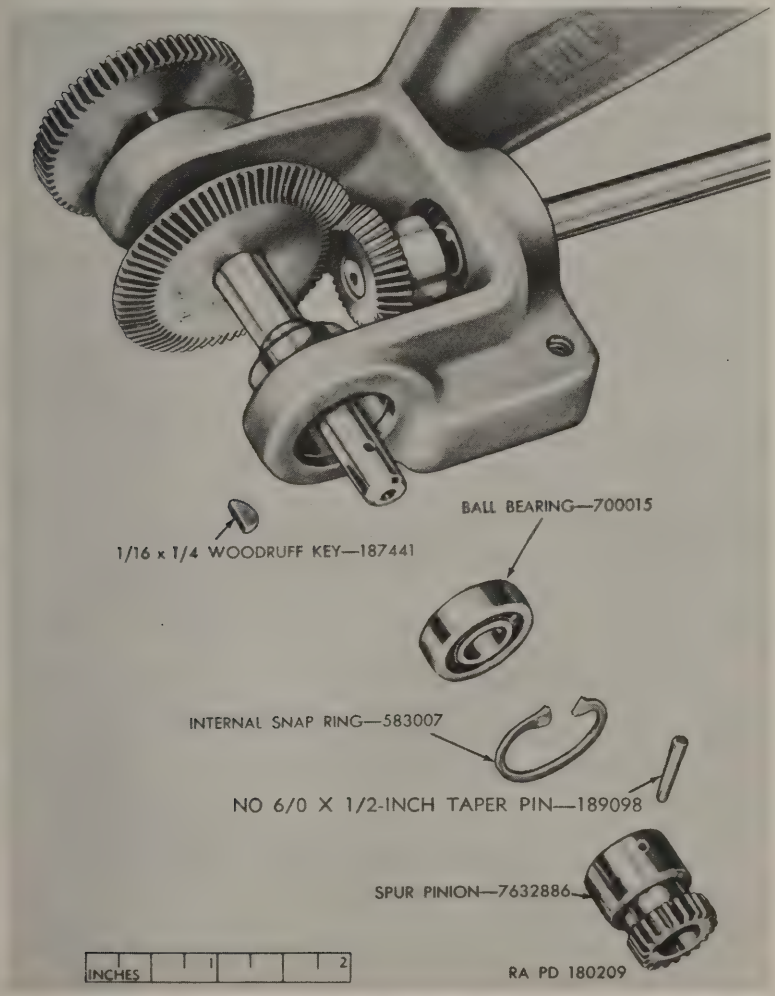


*Figure 270. Ballistic differential assembly—partially exploded view.*

*b.* Compress the internal snap ring with snap ring pliers and lift the ring from the bracket.

*c.* Drive the taper pin (fig. 271) from the spur gear and pull the gear from the shaft. Compress the snap ring with snap ring pliers and lift the ring from the bracket.

*d.* Drive the taper pins from the bevel gear and the collar and pull the shaft part way from the bracket with the ball bearing on the shaft.

*e.* Unscrew the collar from the shaft and slide the shaft from the bracket to free the collar and the gear.

*f.* Slide the ball bearing from the shaft and tap the other ball bearing from the bracket (fig. 270).

*g.* Drive the taper pin (fig. 272) from the spur gear and slide the gear from the shaft.

*h.* Drive the taper pin from the bevel gear (par. 59*a*) and tap the other end of the shaft to drive it through the bevel gear and the two ball bearings. The teeth of the bevel gear can be disengaged from the teeth of the bevel pinion and lifted from the bracket.

*i.* Tap the two ball bearings from the bracket, compress the two retaining snap rings, and lift them from the bracket.

*j.* Drive the taper pin (fig. 273) from the bevel pinion and pull the pinion from the shaft.

*k.* Compress the retaining snap ring with snap ring pliers, lift the snap ring from the shaft, and tap the ball bearing from the bracket.

*l.* Drive the two straight pins (fig. 274) from the main bracket. Unscrew the two fillister-head screws and lock washers that secure the bearing bracket to the main bracket.

*m.* Slide the bearing bracket away from the spider assembly to disengage the spur pinion from the spider assembly; then remove the bearing bracket from the main bracket, easing the ballistic shaft through the hole in the main bracket.

*n.* Drive the taper pin from the collar, unscrew the collar from the shaft, and slide the collar back on the shaft away from the bearing bracket.

*o.* Push the shaft through the bearing bracket until the collar strikes the ball bearing. This will move the spur pinion away from the bracket and to the other end of the shaft.

*p.* Drive the taper pin from the pinion (par. 59*a*), pull the pinion from the shaft, pull the shaft from the bearing bracket, and unscrew the collar from the shaft.

*q.* Tap the two ball bearings from the bearing bracket, compress the two retaining snap rings with snap ring pliers, and lift the rings from the bearing bracket.

*r.* Drive the taper pin (fig. 275) from the bevel pinion and pull the pinion from the shaft. Drive the taper pin from the collar and unscrew the collar from the shaft.

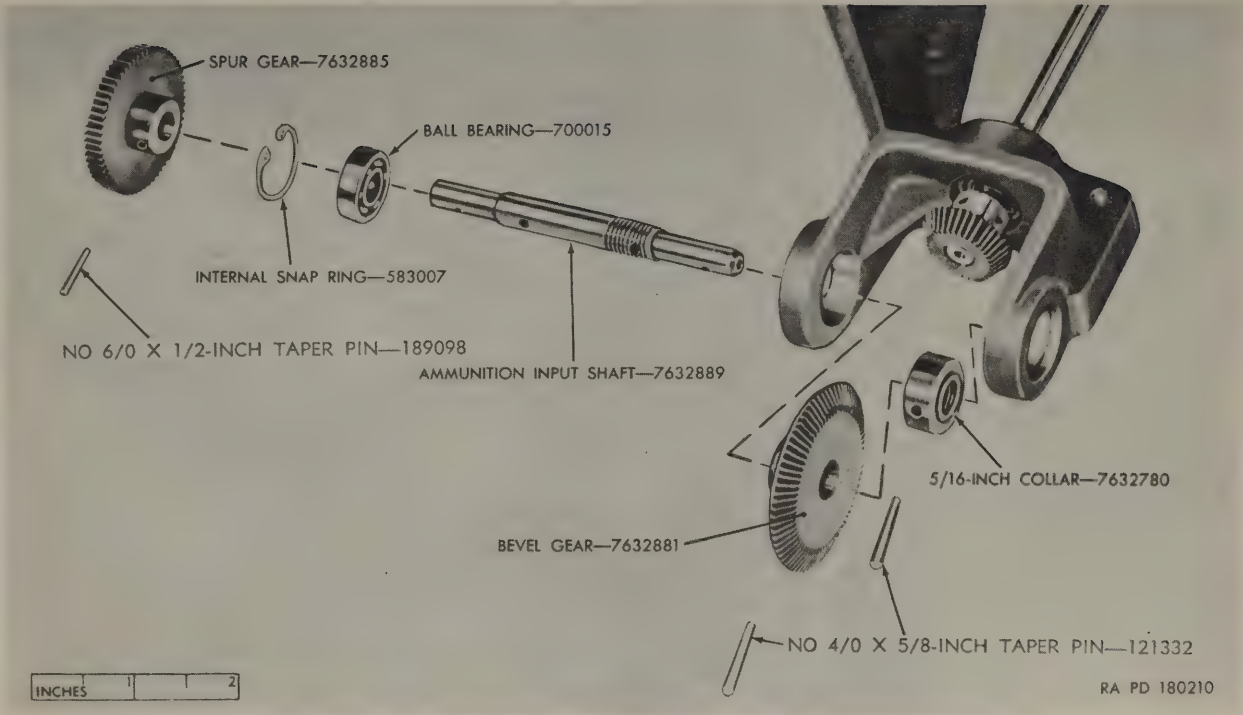


*Figure 271. Ballistic differential assembly—partially exploded view.*

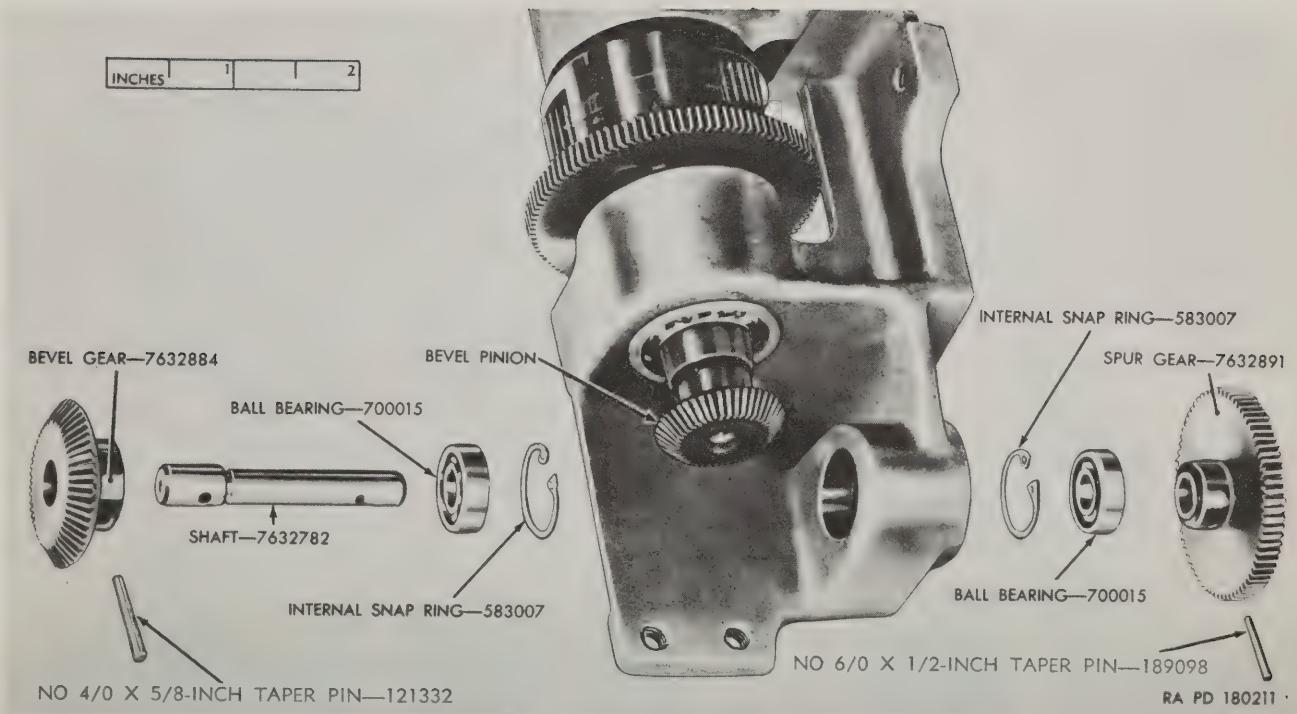


*Figure 272. Ballistic differential assembly—partially exploded view.*

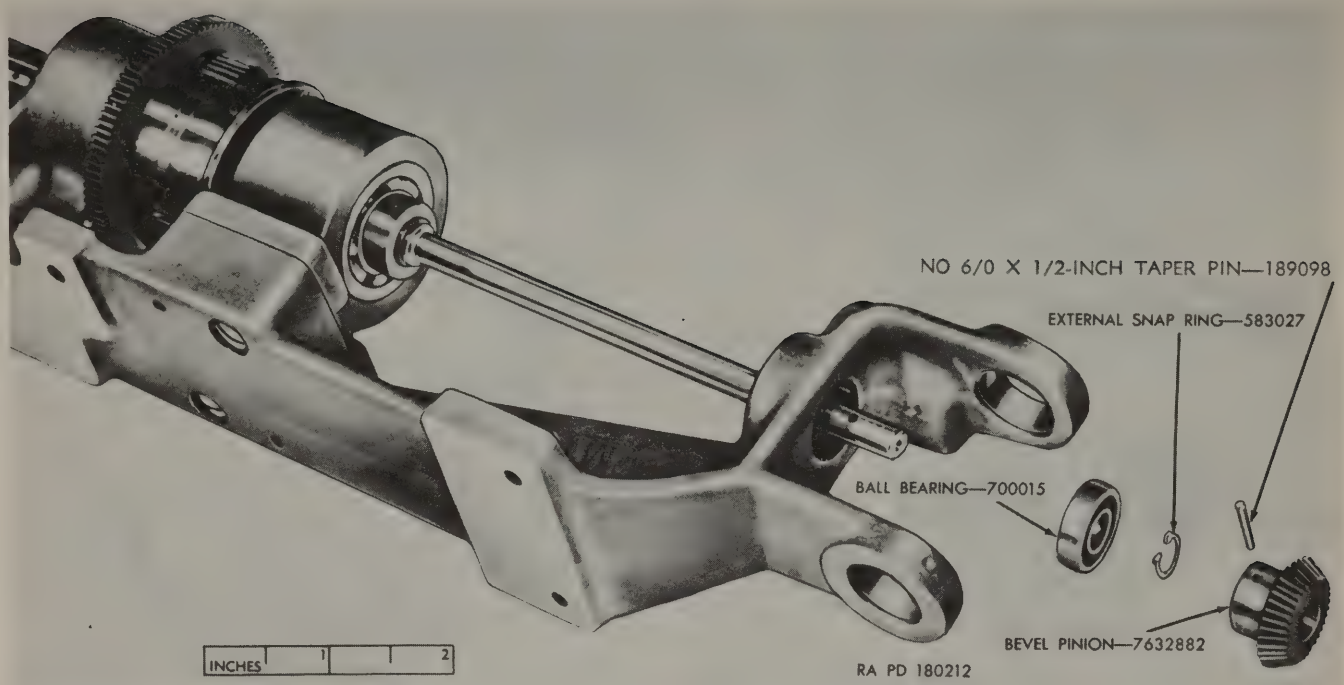


*Figure 273. Ballistic differential assembly—partially exploded view.*

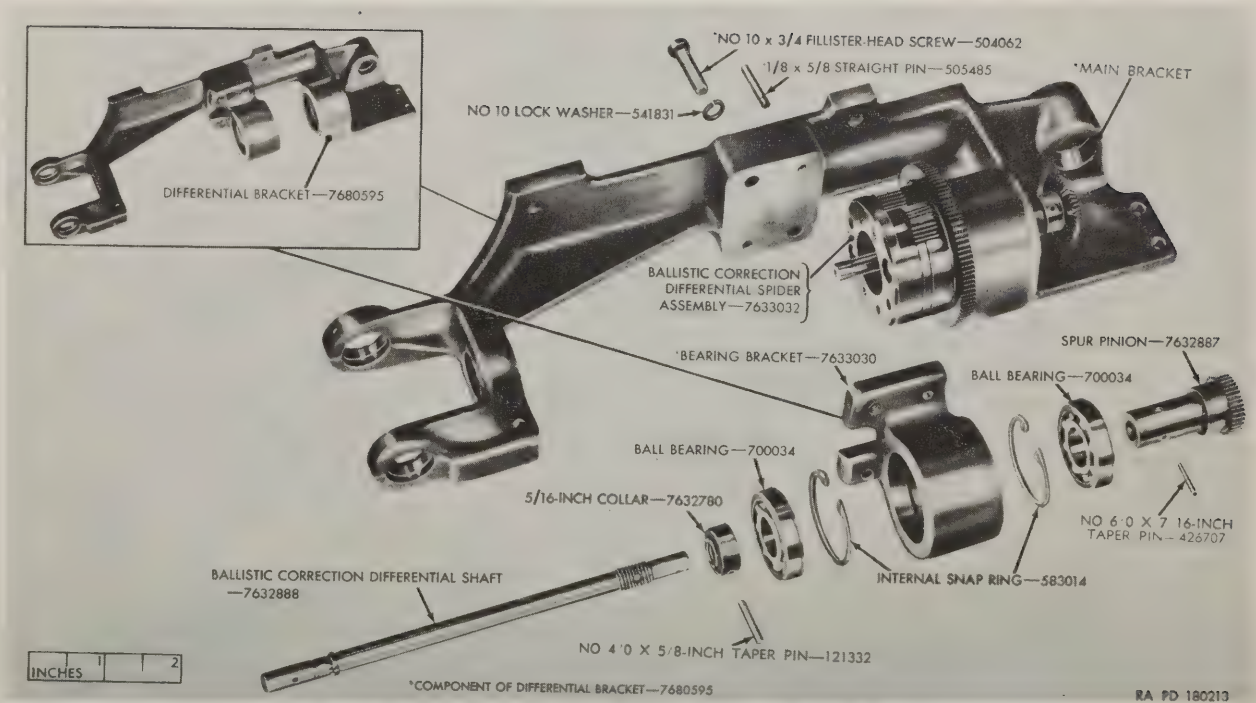


*Figure 274. Ballistic differential assembly—partially exploded view.*

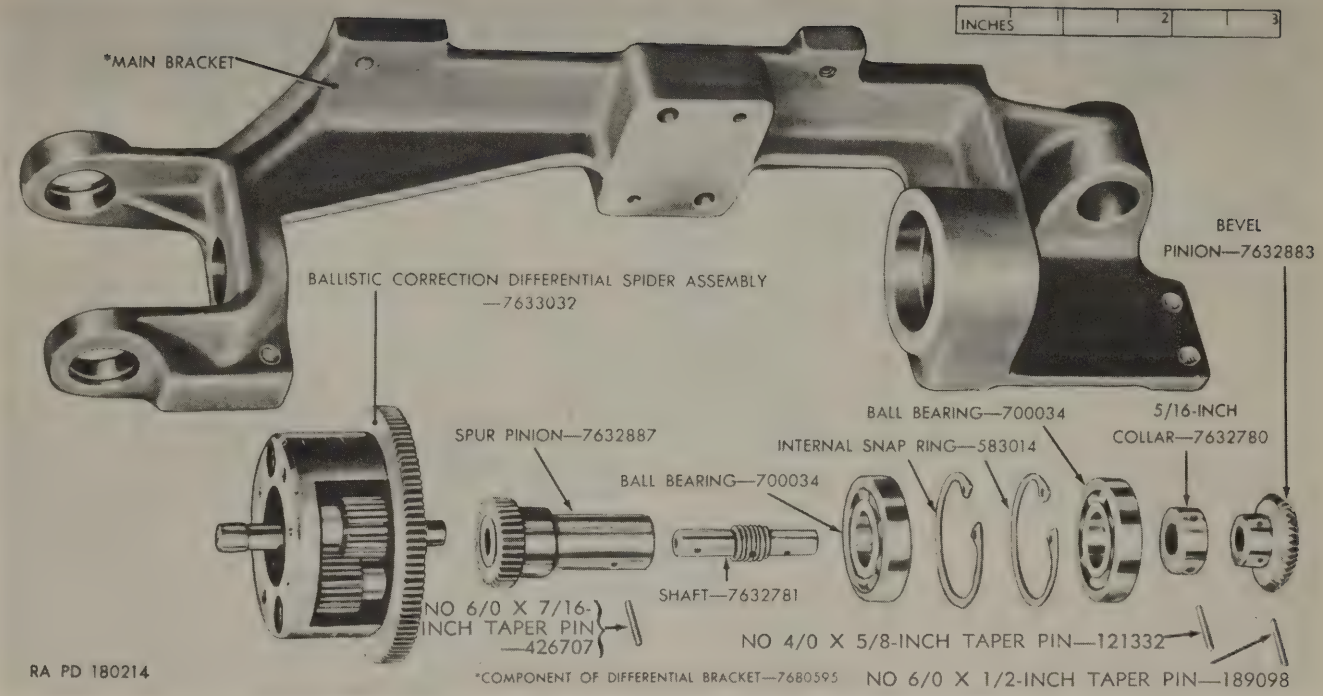


*Figure 275. Ballistic differential assembly—partially exploded view.*

*s.* Pull out the spider assembly, the spur pinion, and the shaft as a unit from the bracket. Pull the spider assembly from the pinion, drive the taper pin from the pinion, and pull the pinion from the shaft.

*t.* Tap the two ball bearings from the bracket, compress the two snap rings with snap ring pliers, and lift the rings from the bracket.

*u.* Disassemble the spider assembly as described in (1) and (2) below.

(1) Unscrew the four fillister-head screws (fig. 276) and lock washers that secure the ring and ring gear to the spider. Drive the two straight pins from the ring and the ring gear.

(2) Pull the ring from the ring gear and the four spur gears and the spider will fall free.

## 222. Disassembly of Elevation Bore Sight Drive Bracket Assembly

*a.* Drive the taper pin (fig. 277) from the gear assembly (par. 59*a*), pull the gear from the shaft, and slide the shaft from the bore sight bracket.

*b.* Tap the two ball bearings from the bracket. Compress the two snap rings using snap ring pliers and lift the rings from the bracket.

*c.* Drive the taper pin from the flexible shaft and pull the flexible shaft from the shaft.

*d.* To disassemble the antibacklash gear assembly, remove the set screw (fig. 278) from the collar and unscrew the collar from the gear. Compress the two springs to remove them from the gears and pull the two gears apart.

*e.* Drive the taper pin (fig. 279) from the spur gear and pull the gear from the shaft. Slide the shaft from the bracket and remove the two ball bearings.

*f.* Compress the two snap rings with snap ring pliers and lift them from the bracket.

*g.* Drive the taper pin (fig. 280) from the 68-tooth spur gear and pull the 26-tooth spur gear from the 68-tooth spur gear and the bracket.

*h.* Tap the two ball bearings from the bracket. Compress the two snap rings with snap ring pliers and lift the rings from the bracket.

## 223. Disassembly of Range Drive Assembly

*a.* Drive the taper pin (fig. 281) from the component gears (par. 59*a*) and slide the gears and spacer from the shaft.

*b.* Tap the shaft from the base to disengage the worm gear assembly from the worm. Tap the ball bearings from the base.

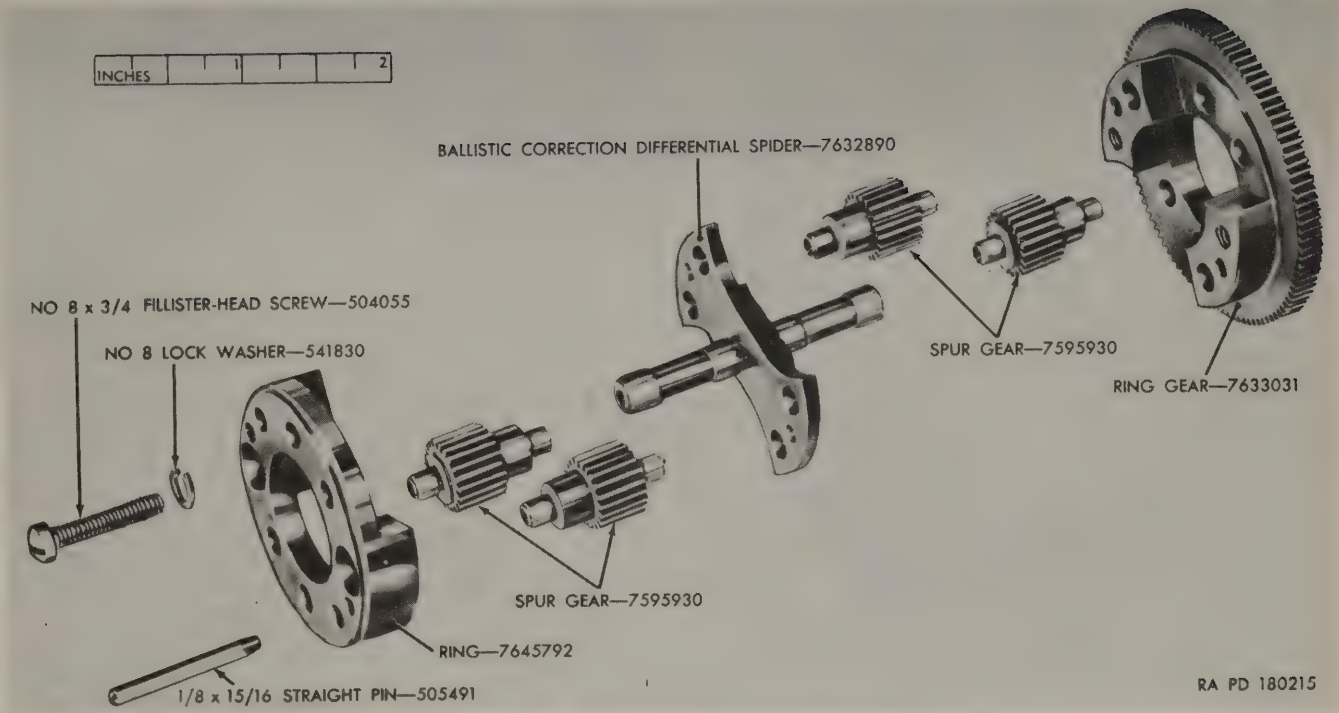


*Figure 276. Spider assembly—exploded view.*

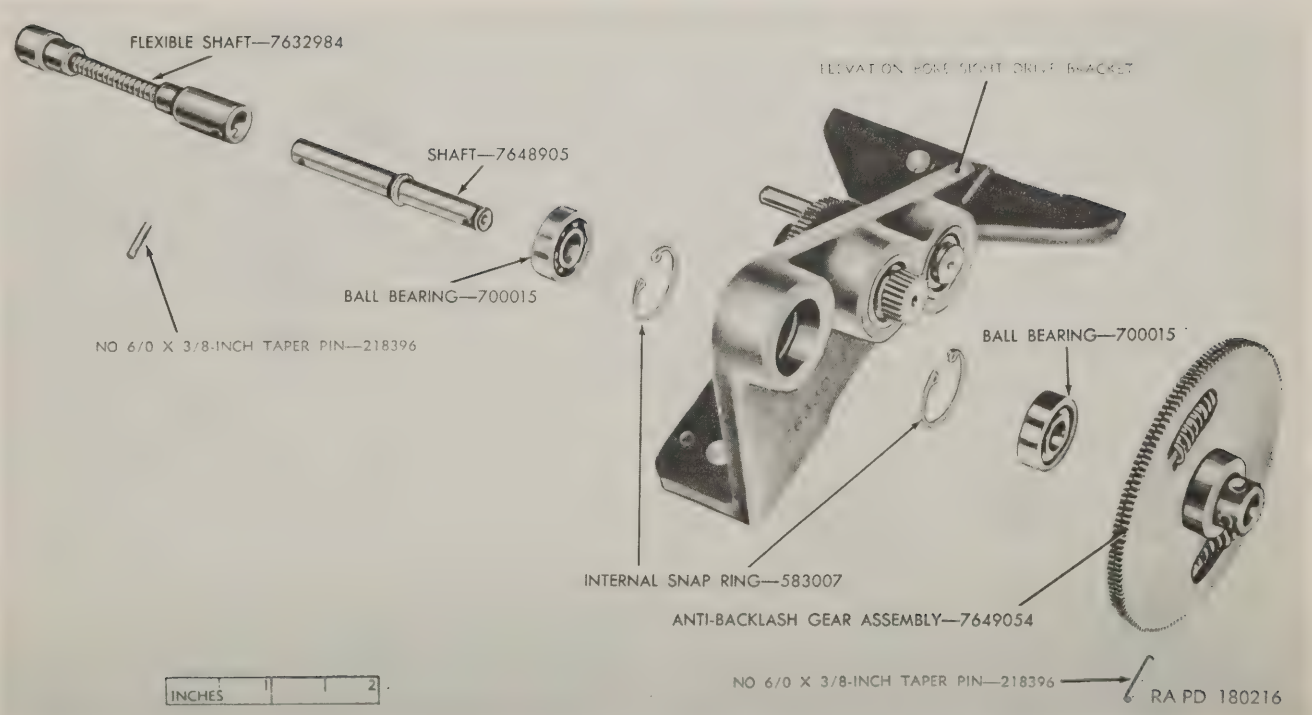


*Figure 277. Elevation bore sight drive bracket assembly—partially exploded view.*

*Figure 278. Antibacklash gear assembly—exploded view.*

*c.* Drive the taper pin from the worm gear assembly and slide the gear assembly from the shaft.

*d.* Compress the snap ring with snap ring pliers and slide the ring from the shaft. Tap the key from the shaft.

*e.* Disassemble the gear assembly as described in (1) and (2) below.

(1) Compress the snap ring with snap ring pliers and lift the ring from the gear.

(2) Pull the two worm gear segments apart and the torsion spring will fall free.

*f.* Drive the taper pin (fig. 282) from the component gears. Unscrew the two fillister-head screws and lock washers from the two component gears.

*g.* Pull the two gears apart and the two plain washers will fall free.

*h.* Drive the taper pin (fig. 283) from the spur gear and slide the component gears from the shaft. Disassemble the component gears following the procedure outlined in *f* and *g* above.

*i.* Drive the taper pin (fig. 284) from the collar. Compress the snap ring with snap ring pliers and lift the ring from the base.

*j.* Tap the shaft from the base with the ball bearing and the collar on the shaft.

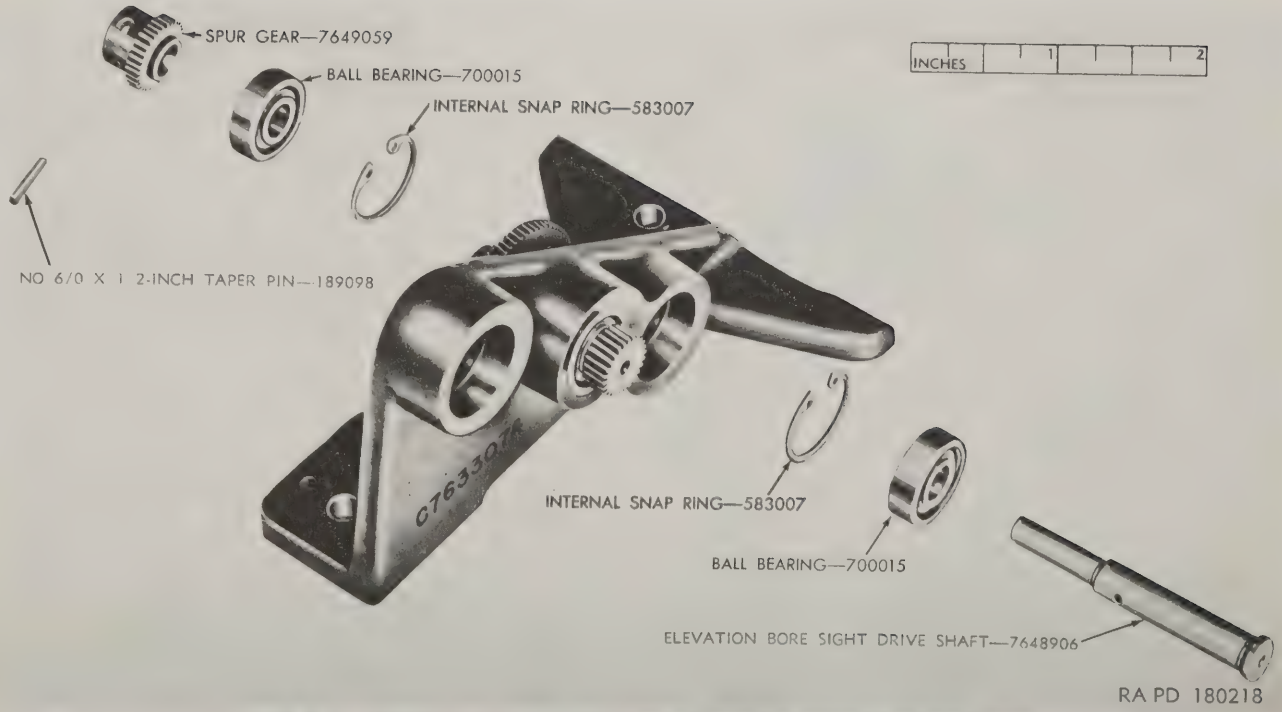


*Figure 279. Elevation bore sight drive bracket assembly—partially exploded view.*

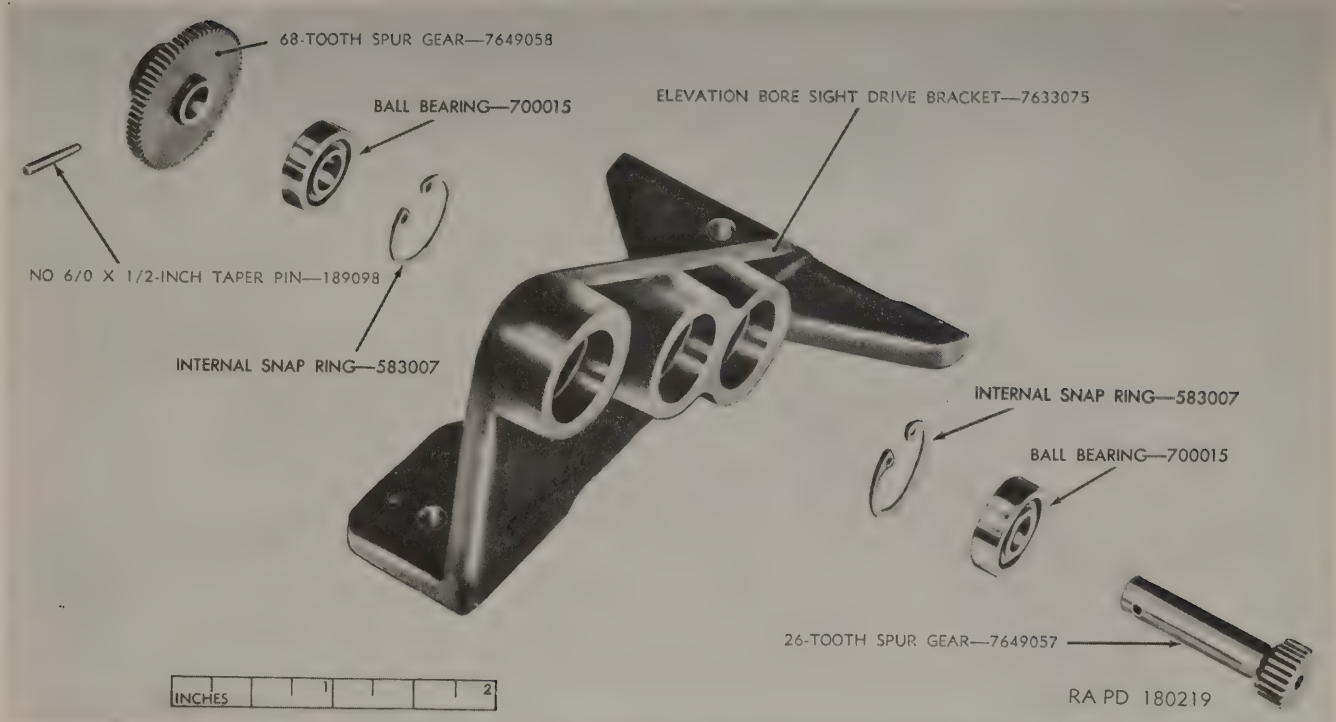


*Figure 280. Elevation bore sight drive bracket assembly—partially exploded view.*

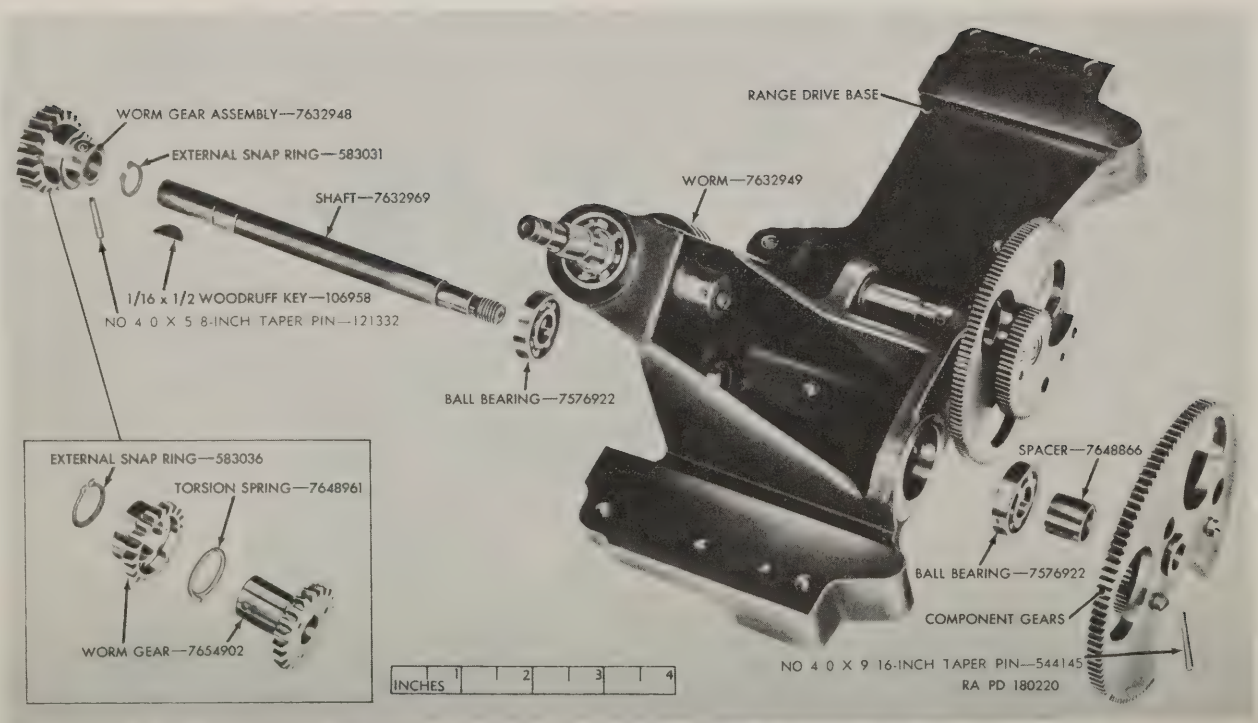


*Figure 281. Range drive assembly—partially exploded view.*

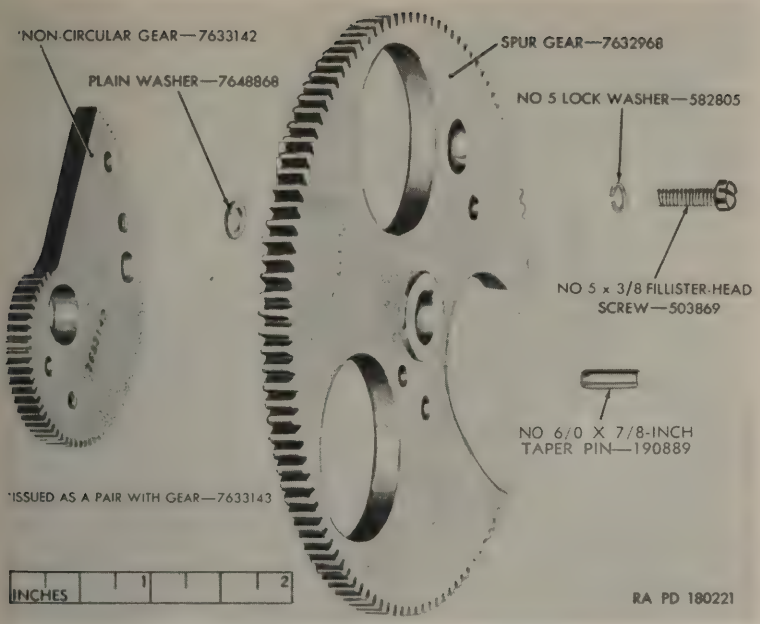


*Figure 282. Component gears—exploded view.*

*k.* Slide the ball bearing and the collar from the shaft and tap the other ball bearing from the base.

*l.* Drive the taper pin (fig. 285) from the collar. Unscrew the collar from the shaft and slide the plain washer from the shaft.

*m.* Compress the snap ring with snap ring pliers and remove the ring from the other end of the shaft.

*n.* Drive one taper pin from the worm and one from the end stop.

*o.* Tap the shaft through the worm and stops and from the base.

*p.* As the shaft is withdrawn the worm and the nine stops will fall from the shaft (fig. 286).

*q.* Tap the two ball bearings (fig. 285) from the base. Remove the key from the shaft (fig. 286).

*r.* Remove the cone-point set screw (fig. 287) and unscrew the stop pin from the base.

## 224. Disassembly of Azimuth Bore Sight Drive Assembly

*a.* Drive the taper pin (fig. 288) from the spur gear (par. 59*a*). Pull the spur gear from the shaft and slide the shaft from the bracket with the coupling attached.

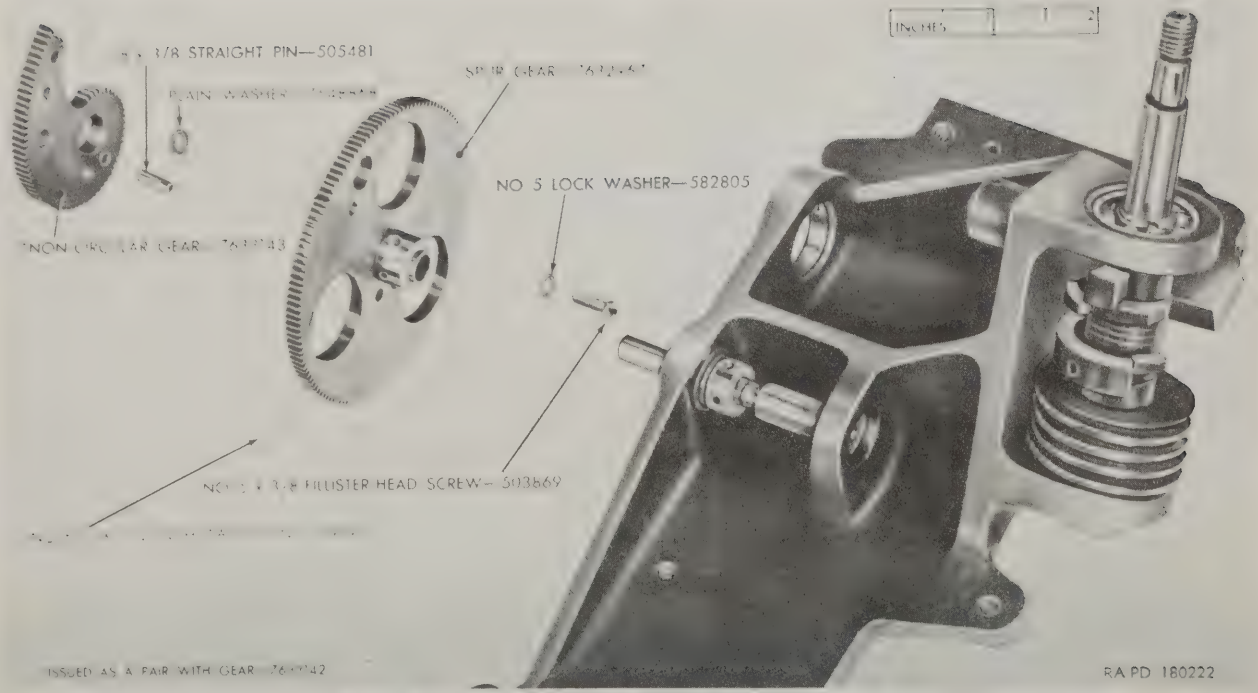


*Figure 283. Range drive assembly—partially exploded view.*

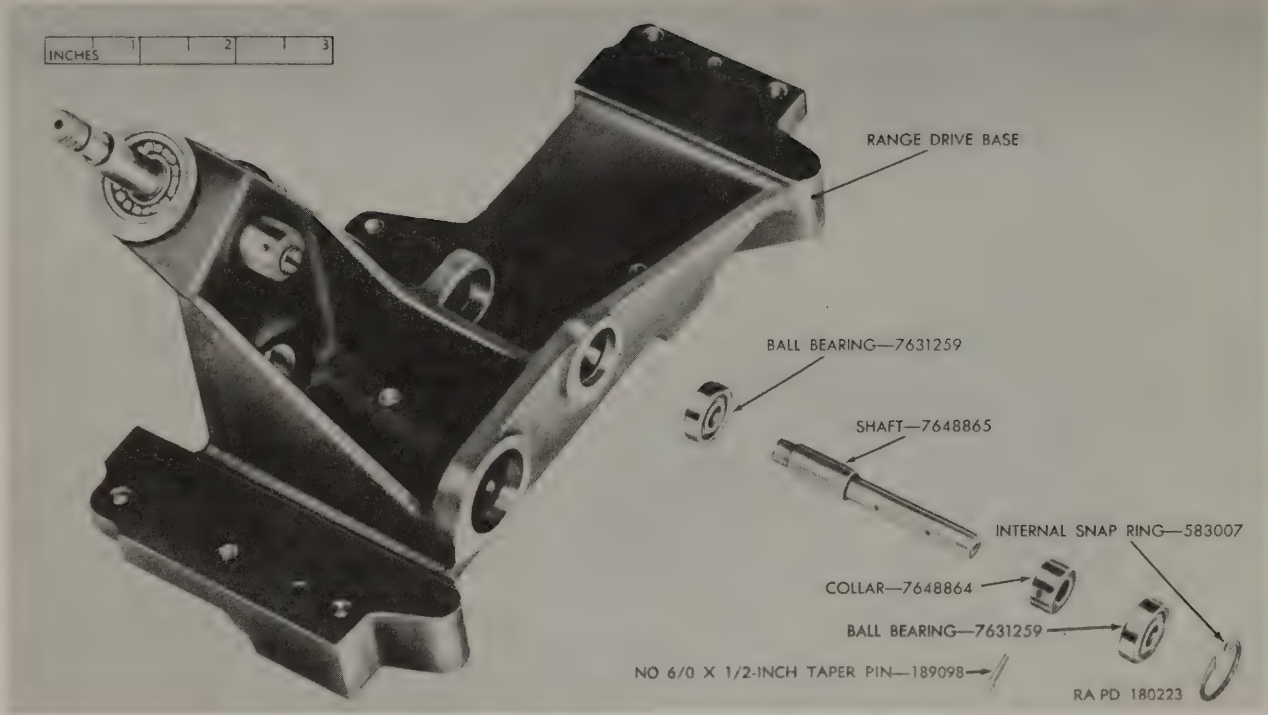


*Figure 284. Range drive assembly—partially exploded view.*

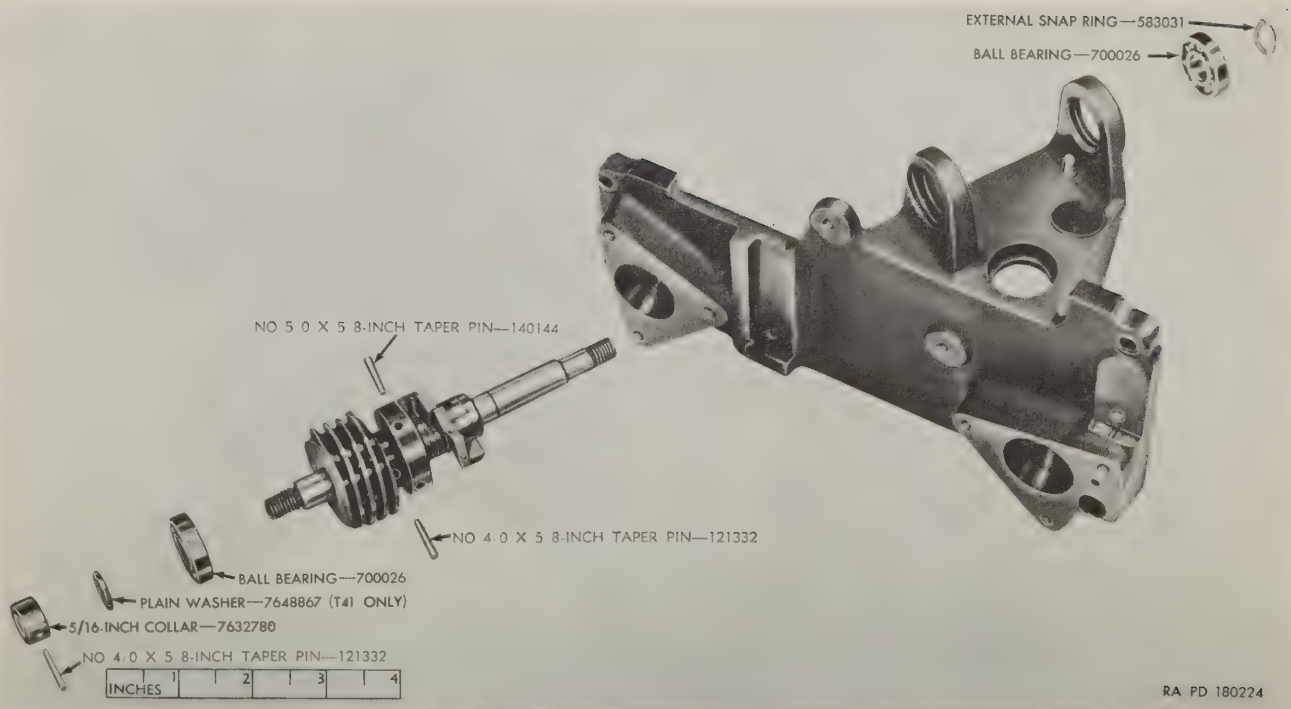
EXTERNAL SNAP RING—583031
BALL BEARING—700026
NO 5 0 X 5 8-INCH TAPER PIN—140144
NO 4 0 X 5 8-INCH TAPER PIN—121332
BALL BEARING—700026
PLAIN WASHER—7648867 (T41 ONLY)
5/16-INCH COLLAR—7632780
NO 4 0 X 5 8-INCH TAPER PIN—121332
INCHES 1 2 3 4
RA PD 180224

*Figure 285. Range drive assembly—partially exploded view.*

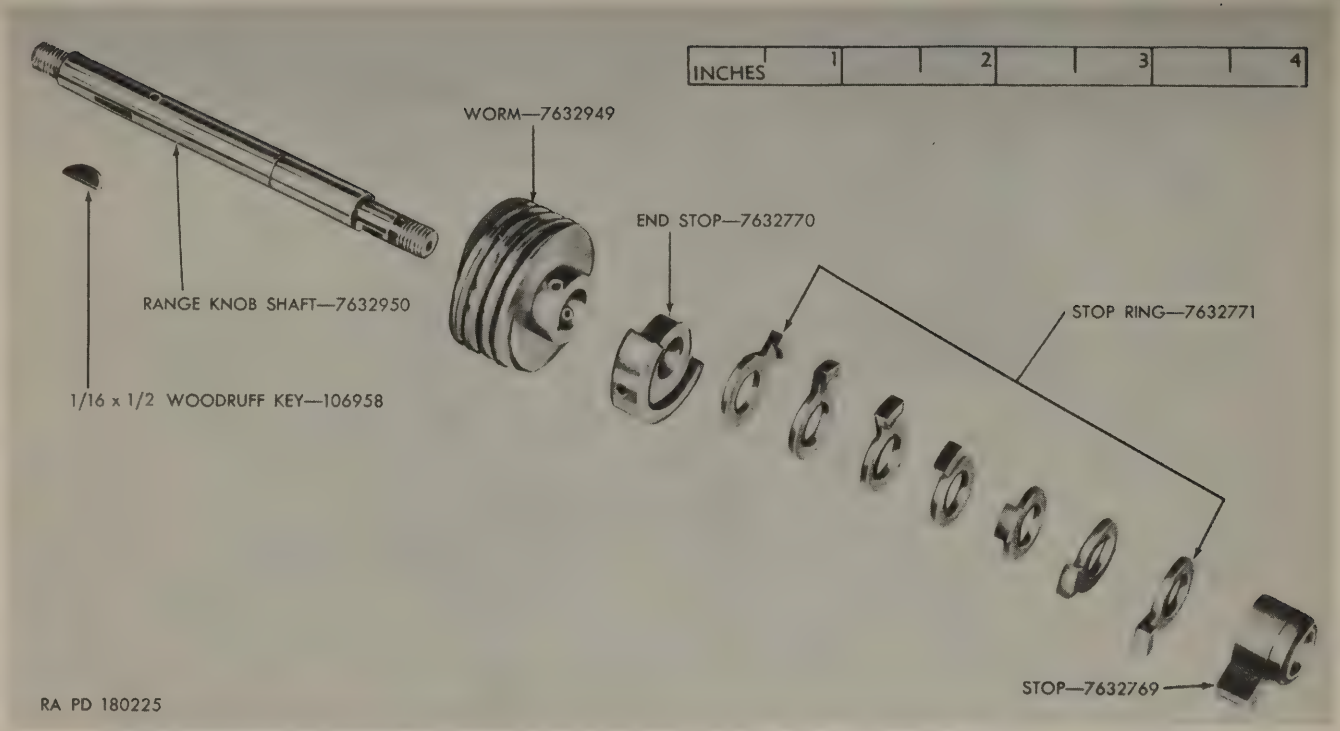


*Figure 286. Range knob shaft, worm, stops and rings—exploded view.*

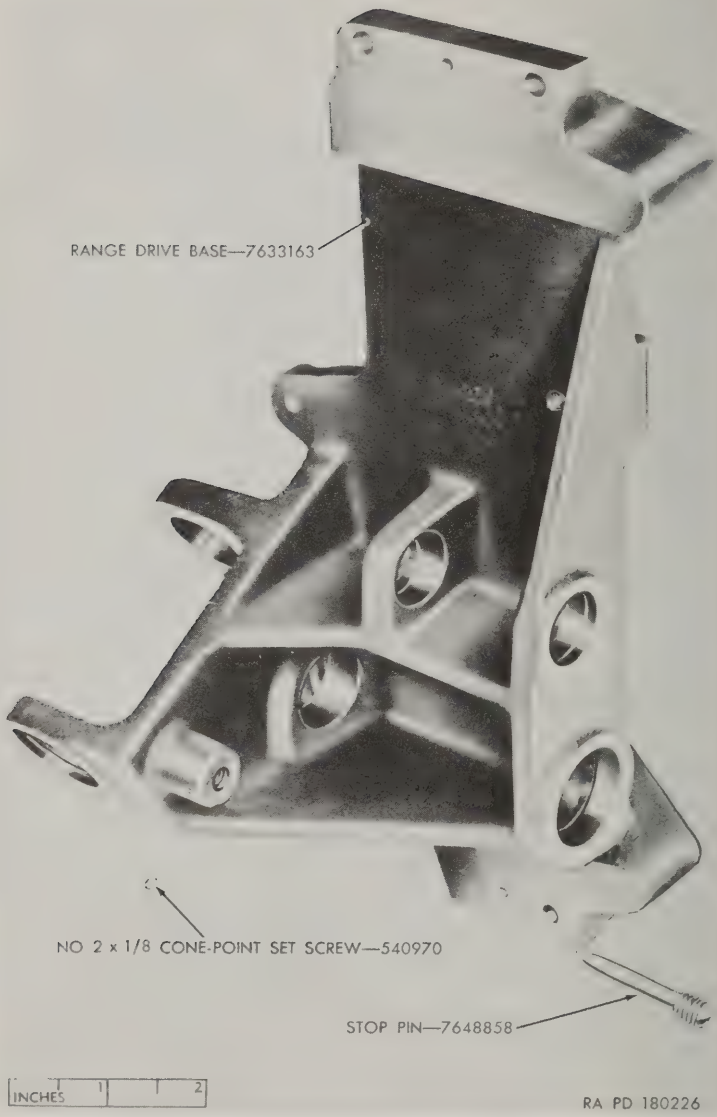


*Figure 287. Range drive assembly—partially exploded view.*

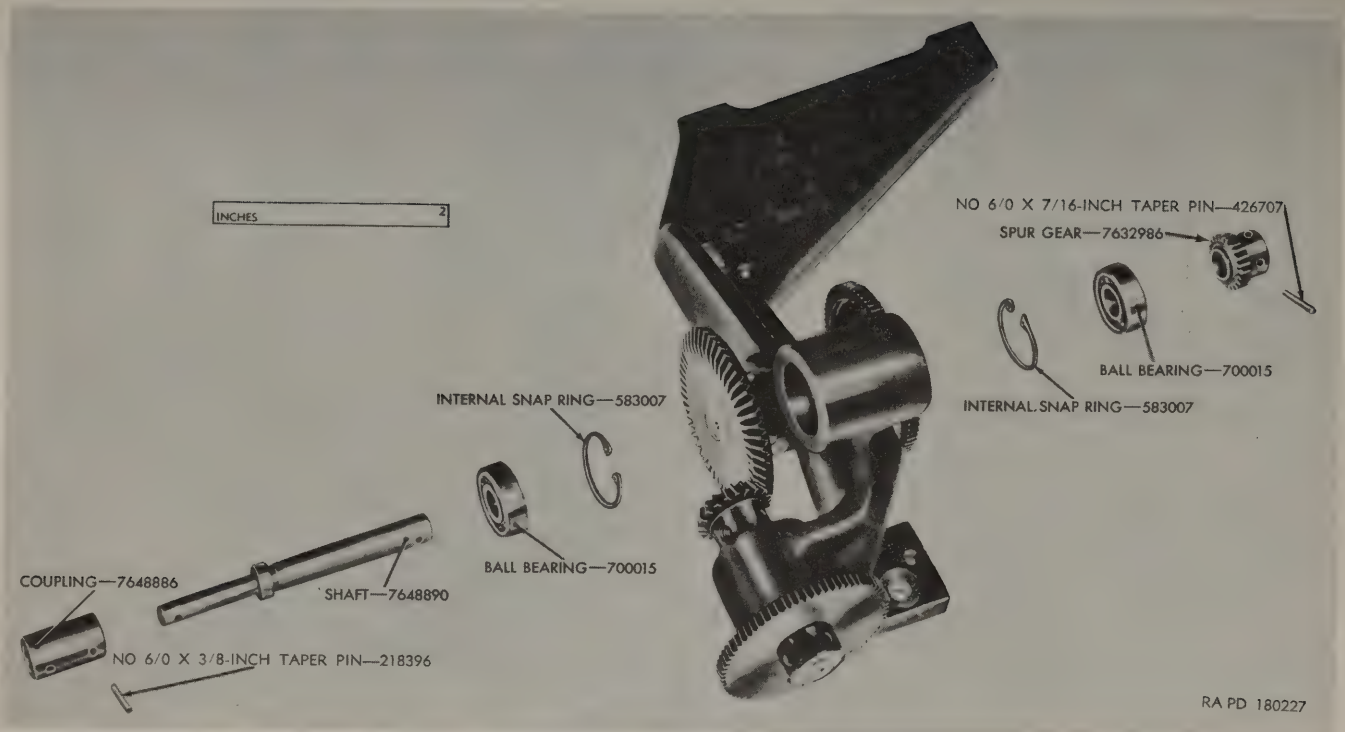


*Figure 288. Azimuth bore sight drive assembly—partially exploded view.*

*b.* Drive the taper pin from the coupling and pull the coupling from the shaft. Tap the two ball bearings from the bracket. Compress the two snap rings with snap ring pliers and lift the rings from the bracket.

*c.* Drive the taper pin (fig. 289) from the bevel gear. Drive the taper pin from the spur gear, pull the spur gear from the shaft, and slide the washer from the shaft.

*d.* Tap the shaft from the bracket and the bevel gear will fall free.

*e.* Tap the two ball bearings from the bracket. Compress the two snap rings and lift the rings from the bracket.

*f.* Drive the taper pin (fig. 290) from the bevel pinion and pull the pinion from the shaft. Drive the taper pin from the spur gear and remove the gear from the shaft.

*g.* Remove the shaft from the bracket. Tap the two ball bearings from the bracket. Compress the two snap rings and lift the rings from the bracket.

### 225. Disassembly of Intermediate Drive Assembly

*a.* Drive the taper pin (fig. 291) from the spur gear (par. 59*a*) and pull the gear from the shaft. Drive the taper pin from the coupling and pull the coupling from the shaft.

*b.* Pull the shaft from the bracket and tap the two ball bearings from the bracket. Compress the two snap rings, using snap ring pliers and lift the rings from the bracket.

*c.* Drive the taper pin (fig. 292) from the female coupling and pull the coupling from the shaft.

*d.* Drive the taper pin from the miter gear. Tap the shaft from the bracket and the gear will fall from the shaft.

*e.* Remove the two ball bearings. Compress the two retaining snap rings with snap ring pliers and lift the rings from the bracket.

*f.* Drive the taper pin (fig. 293) from the gear and pull the gear from the shaft. Drive the taper pin from the collar and unscrew the collar from the shaft. Drive the shaft from the bracket.

*g.* Remove the two ball bearings. Compress the two snap rings with snap ring pliers and lift the rings from the bracket.

### 226. Disassembly of Receptacle Assembly

Unsolder and pull the seven wires (fig. 294) from the receptacle and pull the seven markers from the wires. Unsolder the terminals from the wires.

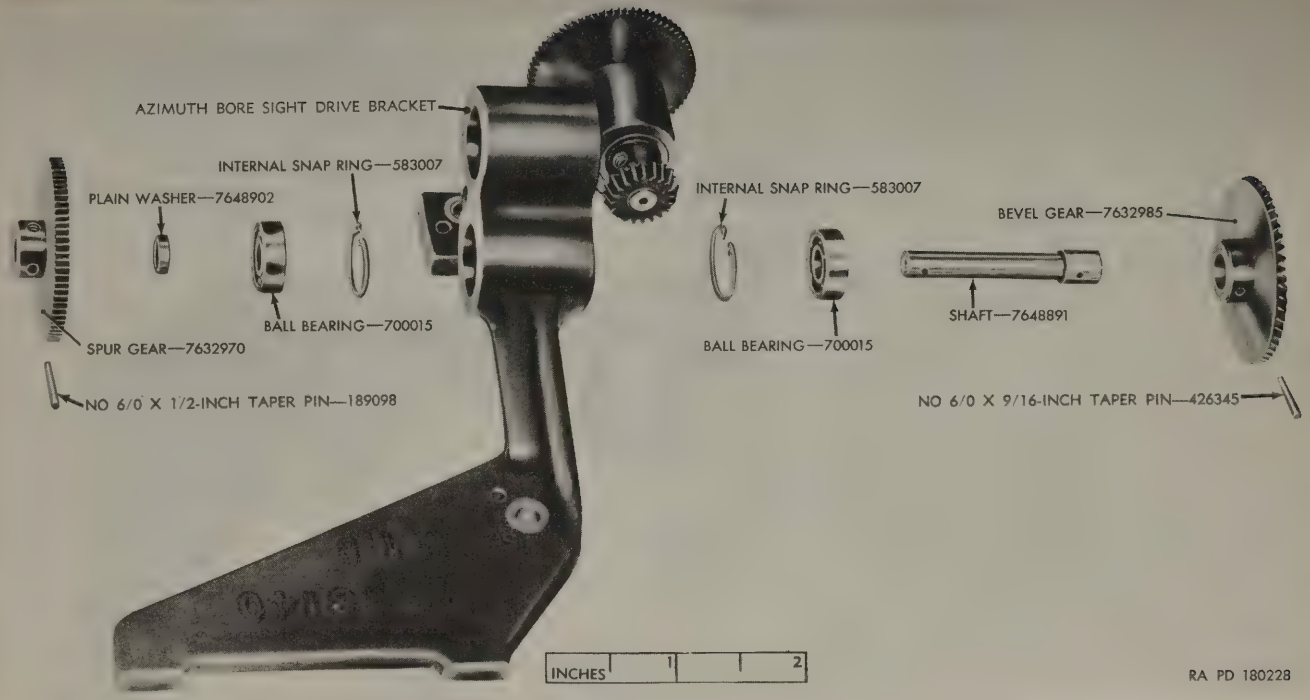


*Figure 289. Azimuth bore sight drive assembly—partially exploded view.*

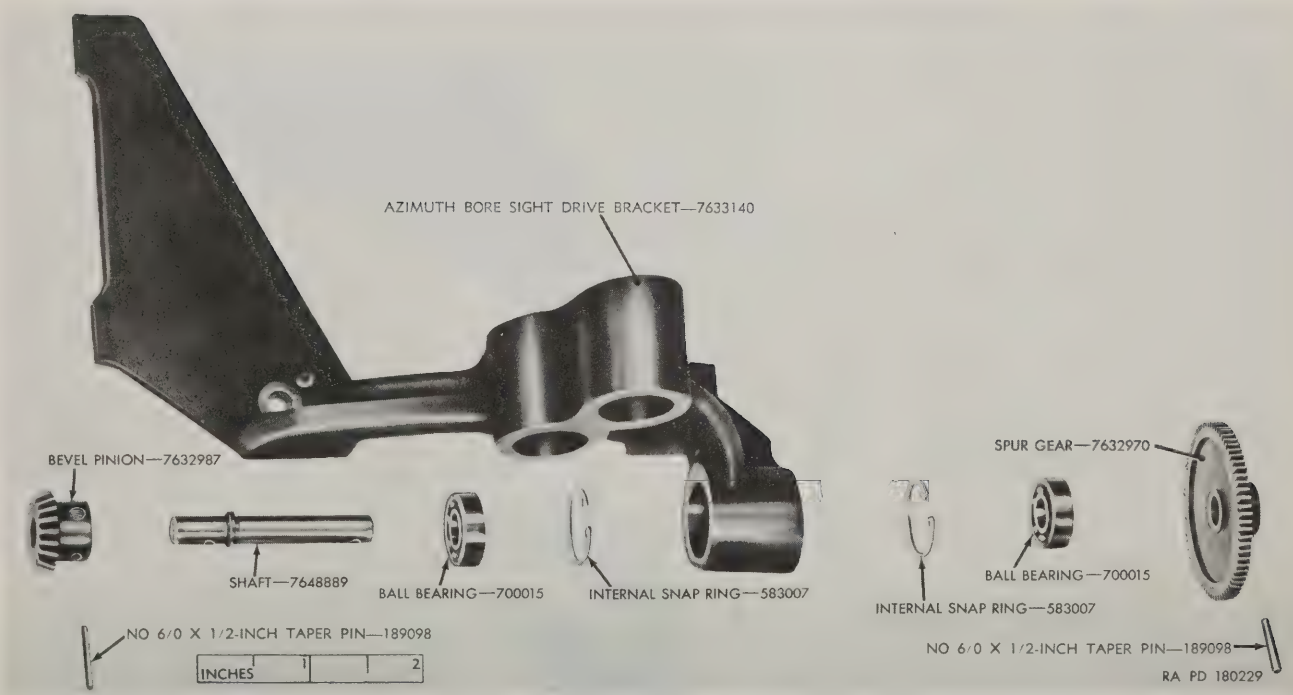


*Figure 290. Azimuth bore sight drive assembly—partially exploded view.*

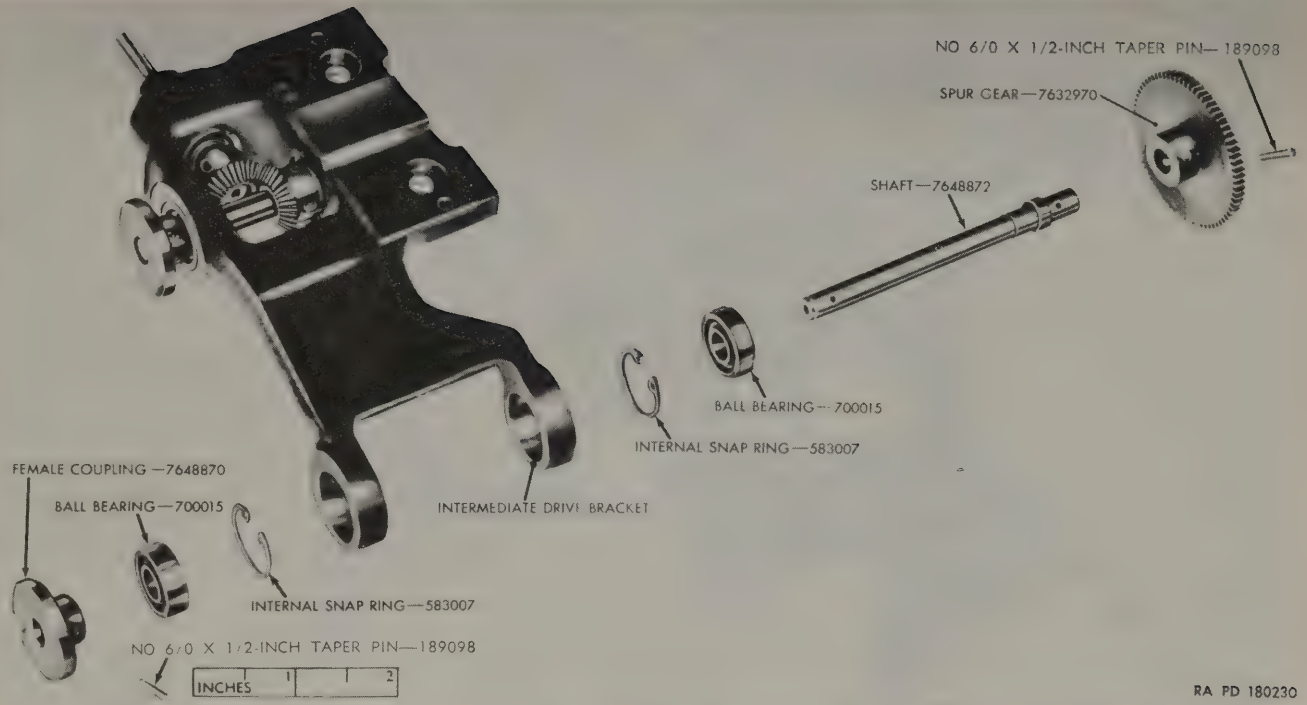


*Figure 291. Intermediate drive assembly—partially exploded view.*

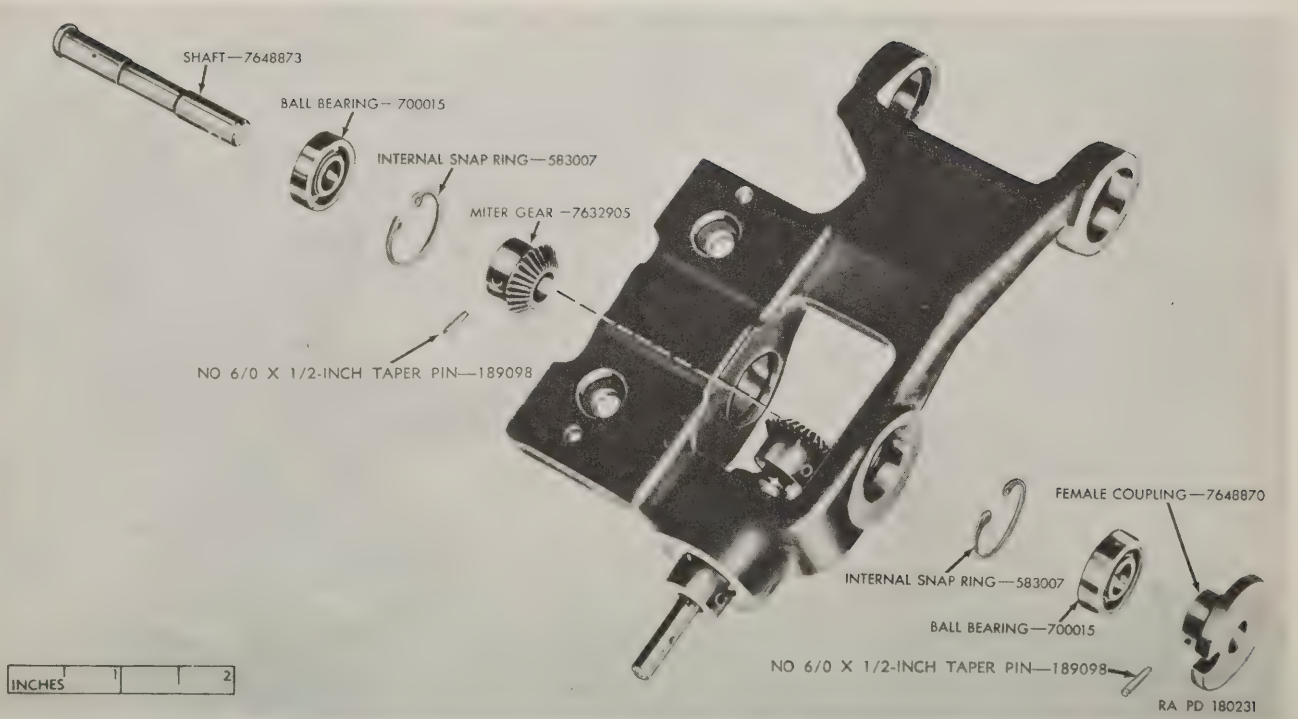


*Figure 292. Intermediate drive assembly—partially exploded view.*

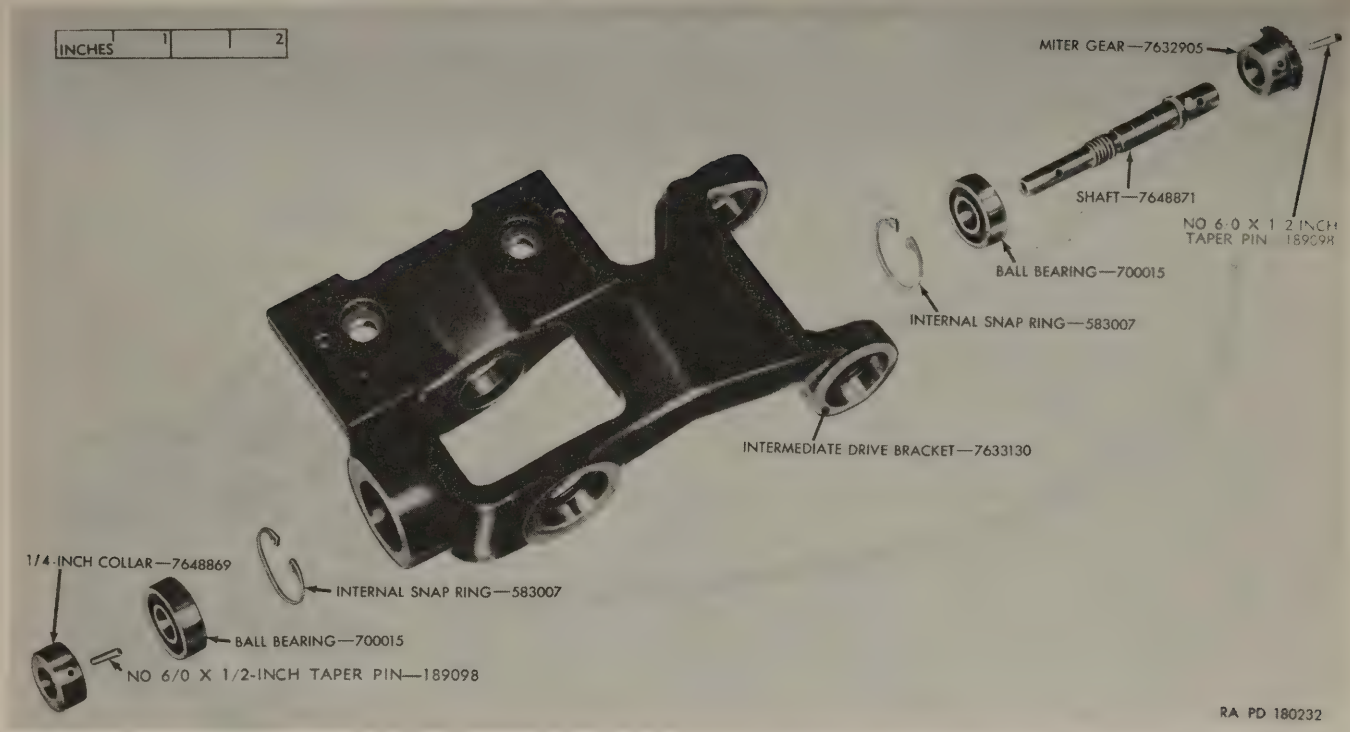


*Figure 293. Intermediate drive assembly—partially exploded view.*

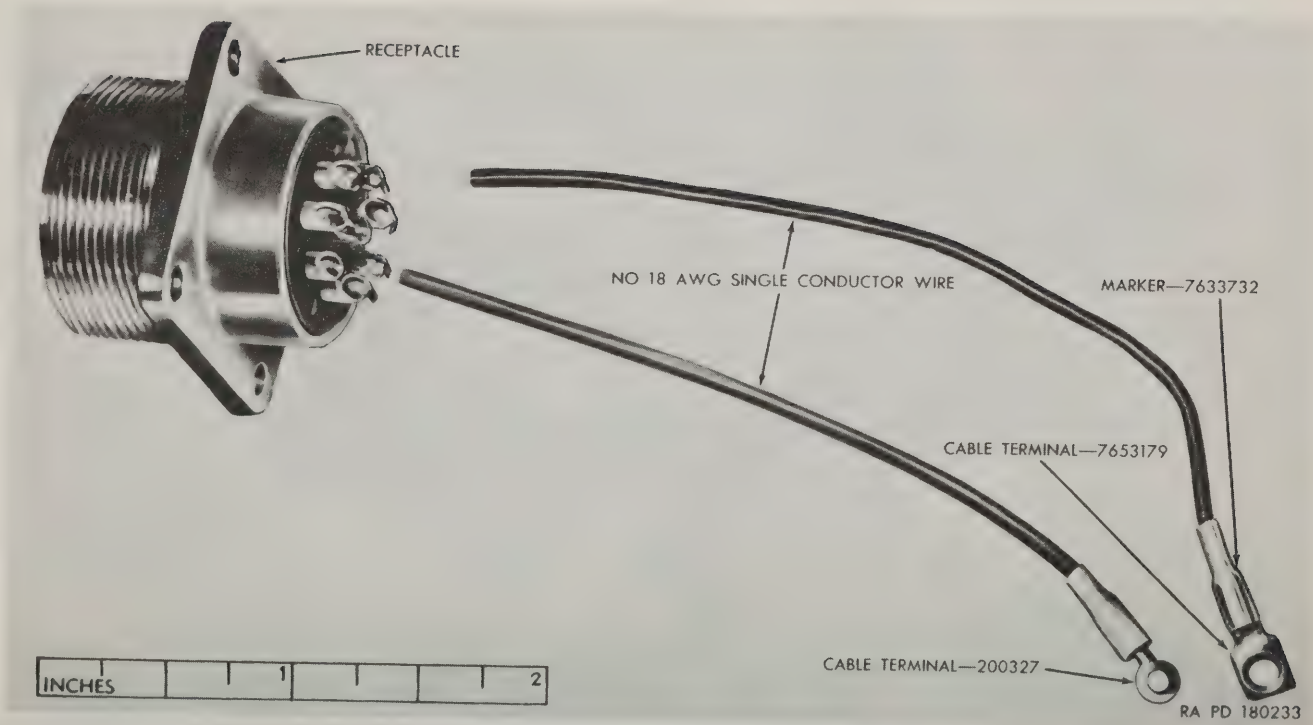


*Figure 294. Receptacle assembly—exploded view.*

## 227. Disassembly of Resistor Board Assembly

*a.* Unscrew the four brass screws (fig. 295) that secure the four cable terminals of the two resistors to the terminal block.

*b.* Unscrew the four fillister-head screws and plain and lock washers that secure the two resistor brackets to the terminal board.

*c.* Unscrew the round-head screw (fig. 296) from the hex nut and remove the lock washer that secures the two resistor brackets to the resistor. Pull the brackets and the screw from the resistor.

*d.* Unscrew the two fillister-head screws (fig. 297) from the two hex nuts and remove the two lock washers that secure the block and the support to the terminal board.

*e.* Unscrew the two flat-head screws from the two hex nuts and remove the two lock washers that secure the other end of the block to the board.

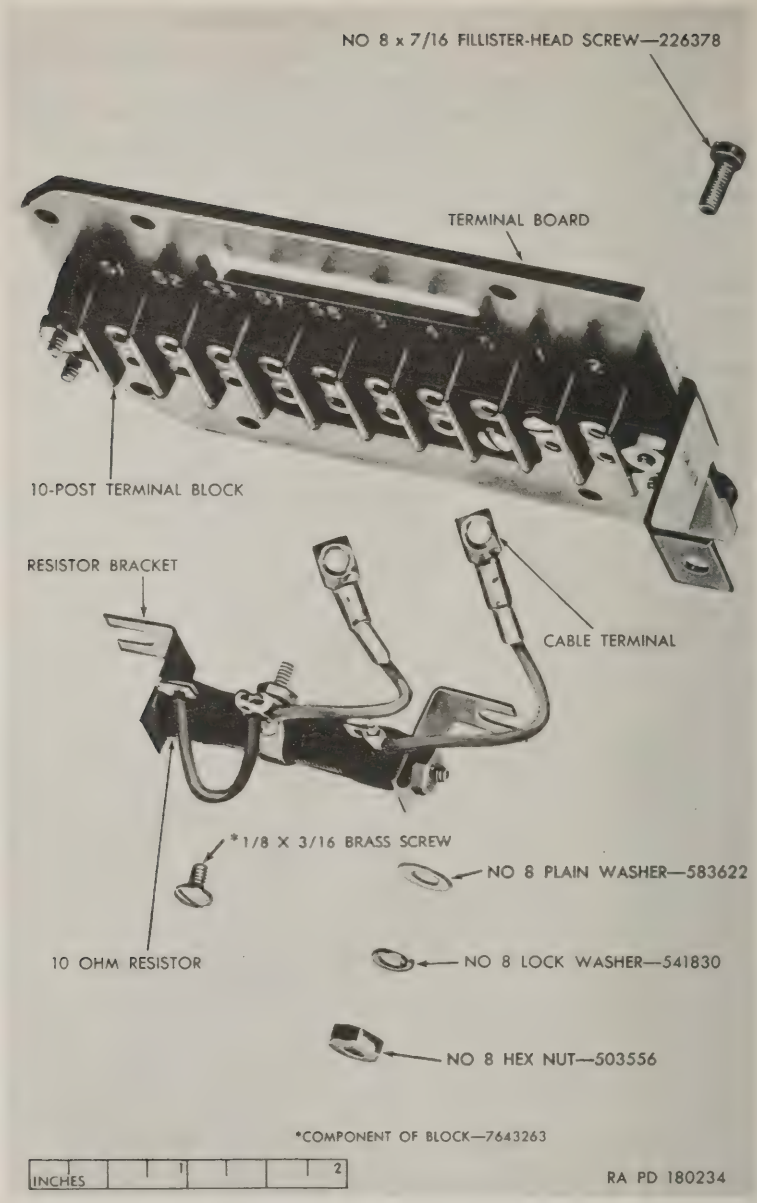


*Figure 295. Resistor board assembly—exploded view.*

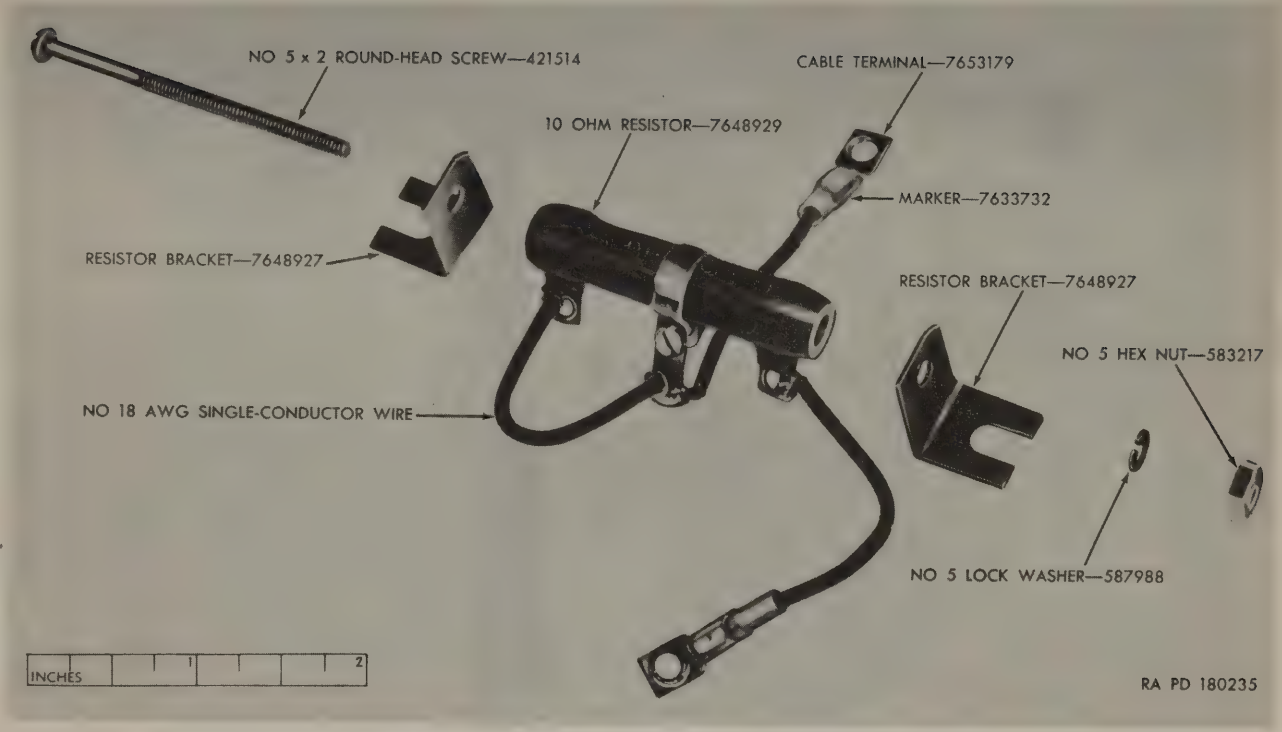


*Figure 296. Resistor and related parts—exploded view.*

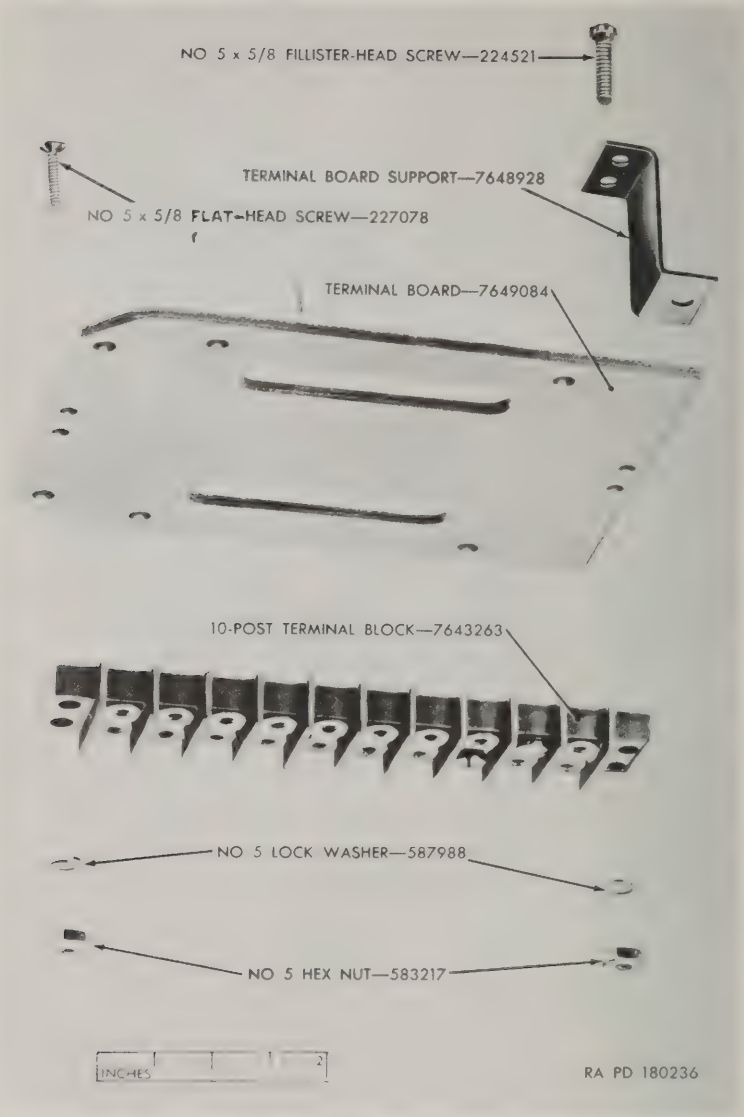


*Figure 297. Terminal board and related parts—exploded view.*

# CHAPTER 7

# ASSEMBLY, TESTS AND ADJUSTMENTS, AND INSTALLATION

## Section I. GENERAL

### 228. Scope

This chapter contains general and specific instructions for the complete repair and rebuild of individual components and of assemblies, in-process inspections, and assembly and installation of all assemblies of the range finder and the installation of the range finder to the on-carriage position.

### 229. Procedure

The individual parts are inspected before assembly and any necessary repair and rebuild operations are performed. Where necessary, tests and adjustments are made on assemblies during the assembly of the range finder. The final tests and adjustments are made after the range finder has been completely assembled.

## Section II. ASSEMBLY OF ASSEMBLIES OTHER THAN TELESCOPE, BALLISTIC CAM, AND COLLIMATOR ASSEMBLIES

### 230. General Rebuild Inspections

*a.* Check all bare metal surfaces for rust or corrosion. Remove rust and corrosion with crocus cloth (par. 55*f*).

*b.* Inspect electric wiring for breaks, frayed cabling, broken insulation, and loose or broken binding cord. Inspect electric connectors for bent or broken pins, broken terminal lugs, loose solder and missing or damaged identification markers.

*c.* Inspect all threaded parts for excessive wear, stripping or damage to threads. Remove burs (par. 55*e*).

*d.* Inspect all parts for cracks or dents. Replace damaged parts with new parts.

*e.* Inspect polished surfaces of optics by looking through them at a bright background. Look for dirt, lint, oil, grease, or moisture. Hold each element under a strong light and against a dark background and slowly rotate and tilt it to visually inspect the optical surfaces. Replace any lens or optical element if it is chipped, scratched, or cracked.

## 231. Assembly of Resistor Board Assembly

*a.* Using an ohmmeter, check the resistance of the resistor. The valve of the resistor should be 10 ohms ± 1 ohm.

*b.* Assemble the 10-post terminal block (fig. 297) and the terminal board support to the terminal board by inserting two No. 5 x 5/8 fillister-head screws through the support and the block and secure with two No. 5 lock washers and two No. 5 hex nuts.

*c.* Insert two No. 5 x 5/8 flat-head screws through the other end of the board and block and secure with two No. 5 lock washers and two No. 5 hex nuts.

*d.* Insert the No. 5 x 2 round-head screw (fig. 296) through the resistor bracket, the 10-ohm resistor, and the other resistor bracket in the order named.

*e.* Slide a No. 5 lock washer on the screw and secure the brackets and resistor with a No. 5 hex nut.

*f.* Assemble the two resistors (fig. 295) and the four resistor brackets to the block and insert the four No. 8 x 7/16 fillister-head screws through the block. Slide four No. 8 plain washers and No. 8 lock washers on the screw and secure everything with four No. 8 hex nuts.

*g.* Secure the four cable terminals to the block with four 1/8 x 3/16 brass screws.

## 232. Assembly of Receptacle Assembly

Check the seven wires (fig. 294) for wear and correct length. Slide the markers onto the wires. Solder the cable terminals to the wires and solder the wires to the eyelets of the receptacle (par. 64).

## 233. Assembly of Intermediate Drive Assembly

*a.* Inspect the gear teeth for wear and if they do not mesh properly, replacements are required. Be sure that the ball bearings are properly lubricated with grease (par. 65*b*) and the drilled holes for the taper pins have not been damaged in the removal of the taper pins. Clean the dirt or grease from the parts (par. 63).

*b.* Compress two internal snap rings (fig. 293) using snap ring pliers and install them in the two recesses in the intermediate drive bracket.

*c.* Tap the two ball bearings into the bracket holes making sure that they fit properly and are not cocked. Slide the shaft through the bearings in the intermediate drive bracket.

*d.* Apply a small amount of grease (par. 65*a* and *b*) on the miter gear, slide the miter gear on the shaft and secure the gear to the shaft by driving a No. 6/0 x 1/2-inch taper pin through the gear and the shaft (par. 59*b*). Slide the 1/4-inch collar on the other end of the shaft and drive a No. 6/0 x 1/2-inch taper pin through the collar and shaft.

*e.* Compress the two internal snap rings (fig. 292) using snap ring pliers and install them in the recesses in the bracket. Tap the two ball bearings into the bracket.

*f.* Apply grease (par. 65*a* and *b*) on the miter gear, position the miter gear in the bracket, meshing its teeth with the teeth of the assembled miter gear and slide the shaft through the bearing, the miter gear, and the other bearing respectively.

*g.* Drive a No. 6/0 x ½-inch taper pin through the miter gear and the shaft to secure the gear to the shaft. Slide the female coupling on the other end of the shaft and secure it to the shaft by driving a No. 6/0 x ½-inch taper pin through the coupling and the shaft.

*h.* Compress the two internal snap rings (fig. 291) using snap ring pliers and install in the recesses in the bracket. Tap the two ball bearings into the bracket making sure that they fit properly and are not cocked.

*i.* Apply grease (par. 65*a* and *b*) on the teeth of the spur gear, slide the spur gear on the shaft and secure it to the shaft by driving a No. 6/0 x ½-inch taper pin through the gear and shaft. Insert the shaft through the bearings in the bracket.

*j.* Slide the female coupling on the shaft and secure it by driving a No. 6/0 x ½-inch taper pin through the coupling and the shaft.

## 234. Assembly of Azimuth Bore Sight Drive Assembly

*a.* Compress the two internal snap rings (fig. 290) using snap ring pliers and install them in the recesses in the azimuth bore sight drive bracket.

*b.* Slide the bevel gear on the shaft and secure it to the shaft by driving a No. 6/0 x ½-inch taper pin through the gear and the shaft (par. 59*b*).

*c.* Apply grease (par. 65*a* and *b*) to the two ball bearings, tap the ball bearings into the bracket and insert the shaft through the bearings in the bracket. Apply grease to the teeth of the spur gear, slide the spur gear on the other end of the shaft and secure the gear to the shaft by driving a No. 6/0 x ½-inch taper pin through the gear and the shaft.

*d.* Compress the two snap rings (fig. 289) using snap ring pliers and install them in the recesses in the bracket. Tap the two ball bearings into the bracket holes.

*e.* Apply grease to the teeth of the bevel gear, slide the bevel gear on shaft, and secure the gear to the shaft by driving a No. 6/0 x 9/16-inch taper pin through the gear and the shaft. Insert the shaft through the bearings in the bracket.

*f.* Slide the plain washer and the spur gear on the shaft, meshing the spur gear teeth with the teeth of the pinion gear. Secure the spur

gear to the shaft by driving a No. 6/0 x ½-inch taper pin through the gear and the shaft.

*g.* Compress the two snap rings (fig. 288) using snap ring pliers and install them in the recesses in the bracket. Apply grease (par. 65*a* and *b*) to the two ball bearings and tap the bearings into the bracket. Slide the coupling on the shaft and secure it to the shaft by driving a No. 6/0 x ⅜-inch taper pin through the coupling and the shaft.

*h.* Insert the shaft through the bearings in the bracket, slide the spur gear on the shaft, and secure the gear to the shaft by driving a No. 6/0 x 7/16-inch taper pin through the gear and the shaft. Apply grease to the teeth of the spur gear.

## 235. Assembly of Range Drive Assembly

*a.* Carefully inspect the gears for wear to insure that they will mesh properly and replace if the condition warrants. Apply grease (par. 65*a* and *b*) to the teeth of all gears and to all ball bearings before assembling.

*b.* Screw the stop pin (fig. 287) into the range drive base and secure it with the No. 2 x ⅛ cone-point set screw.

*c.* Tap a 1/16 x ½ woodruff key (fig. 286) into the recess in the shaft. Tap the ball bearing (fig. 285) into the base at the stop pin end.

*Note.*—The other woodruff key will be assembled to the shaft when the range knob and sealing plate are installed.

*d.* Compress the external snap ring using snap ring pliers and install it in the recess in base.

*e.* Hold the worm, the end stop, the seven stop rings, and the stop respectively (fig. 286) in position on the base. Insert the range knob shaft, first through the base opening (fig. 285); then through the worm, the nine stops, and the bearing.

*f.* Drive in a No. 5/0 x ⅝-inch taper pin (par. 59*b*) to secure the end stop to the shaft and a No. 4/0 x ⅝-inch taper pin to secure the worm to the shaft.

*g.* Tap the other ball bearing into the base and slide the plain washer on the shaft. Screw the 5/16-inch collar on the shaft securing it to the shaft by driving a No. 4/0 x ⅝-inch taper pin through the collar and the shaft.

*h.* Tap the ball bearing into the range drive base (fig. 284) and while holding the collar in position in front of the ball bearing, insert the shaft through the hole in the base, through the collar, and into the bearing in the base.

*i.* Tap the other ball bearing into the base and using snap ring pliers, compress the internal snap ring and install it in the recess in the base.

*j.* Secure the collar to the shaft by driving a No. 6/0 x ½-inch taper pin through the collar and the shaft.

*k.* To assemble the component gears, drive a ⅛ x ⅜-inch straight pin (fig. 283) into the drilled hole of the noncircular gear. Position the spur gear on the pin in the noncircular gear, line up the threaded holes with the two plain washers and secure the gears with the two No. 5 x ⅜-inch fillister-head screws and two No. 5 lock washers at the screw heads.

*l.* Slide the component gears on the shaft and secure to the shaft with a No. 6/0 x ½-inch taper pin through the spur gear and the shaft.

*m.* To assemble the component gear (fig. 282), follow the same procedure as described in *k* above.

*n.* To assemble the worm gear assembly compress the external snap ring (fig. 281) using snap ring pliers and install it in the outer section of the worm gear. Position the torsion spring in the same gear segment, slide the gear segments together.

*o.* Tap the two ball bearings into the range drive base. Slide the external snap ring on the shaft, tap a 1/16 x ½ woodruff key into the recess in the shaft, and slide the worm gear assembly on the shaft. Secure it with a No. 4/0 x ⅝-inch taper pin through the gear and the shaft.

*p.* Insert the shaft with the affixed worm gear assembly through the bearings in the base, meshing the teeth of the worm gear assembly with the threads of the worm. Slide the spacer and the component gears on the shaft and secure the component gears to the shaft by driving a No. 4/0 x 9/16-inch taper pin through the spur gear of the component gears and the shaft.

## 236. Assembly of Elevation Bore Sight Drive Assembly

*a.* Compress the two internal snap rings (fig. 280) with snap ring pliers, install them in the recesses in the elevation bore sight drive bracket and tap the two ball bearings into the bracket.

*b.* Carefully inspect the bracket and bracket bearing for cracks or abrasions and replace if the condition warrants. The mounting surfaces must be smooth and free from any irregularities which would change the normal mounting position. Apply grease (par. 65*a* and *b*) to all gear teeth and to all ball bearings before assembling.

*c.* Insert the 26-tooth spur gear into the two ball bearings through the bracket. Slide the 68-tooth spur gear on the 26-tooth spur gear and secure it by driving a No. 6/0 x ½-inch taper pin through the gears (par. 59*b*).

*d.* Compress the two internal snap rings (fig. 279), using snap ring pliers, install them in the recesses in the bracket. Tap the two ball bearings into the bracket. Insert the elevation bore sight drive shaft in the bracket.

*e.* Slide the spur gear on the shaft, secure it to the shaft with a No. 6/0 x ½-inch taper pin through the gear and the shaft.

*f.* To assemble the antibacklash gear assembly, assemble the spur gears so that the openings for the springs line up. Compress the compression springs (fig. 278) and hook them on the spur gears. Screw a 7/16-inch collar on the 143-tooth spur gear and secure the collar with a No. 2 x ⅛-inch cone-point set screw through the collar to the gear.

*g.* Compress the two internal snap rings (fig. 277) and install them in the bracket recesses of the elevation bore sight drive bracket. Tap the two ball bearings into the bracket and insert the shaft through the ball bearings in the bracket.

*h.* Slide the antibacklash gear assembly on the shaft, secure to the shaft by driving a No. 6/0 x ⅜-inch taper pin through the gear and the shaft. Slide the flexible shaft on the shaft and secure it by driving a No. 6/0 x ⅜-inch taper pin through the two shafts.

## 237. Assembly of Ballistic Differential Assembly

*a.* Carefully inspect the bracket and bracket bearing for cracks or abrasions and replace if the condition warrants. The mounting surfaces must be smooth and free from any irregularities which would change the normal mounting position. Apply grease (par. 65*a* and *b*) to all ball bearings and to all gear teeth before assembling.

*b.* To assemble ballistic correction differential spider assembly, insert the four spur gears (fig. 276) in the ring and the ring gear and place the ballistic correction differential spider so that the threaded and drilled holes of the spider and the ring gear line up. Position the ring on the spider so that the threaded and the drilled holes also line up, drive the two ⅛ x 15/16 straight pins into the drilled holes and secure the rings and the spider with four No. 8 x ¾ fillister-head screws and four No. 8 lock washers.

*c.* Compress the two internal snap rings (fig. 275) with snap ring pliers and install them in the recesses in the main bracket. Tap the two ball bearings into the main bracket. Slide the spur pinion on the shaft and secure it by driving a No. 6/0 x 7/16-inch taper pin through the pinion and the shaft.

*d.* Insert the shaft with the pinion into the bracket, screw the 5/16-inch collar on the shaft, and secure it by driving a No. 4/0 x ⅝-inch taper pin through the collar and the shaft.

*e.* Slide the bevel pinion on the shaft, secure it with a No. 6/0 x ½-inch taper pin through the pinion and the shaft and slide the ballistic correction differential spider assembly into the spur pinion.

*f.* Compress the two internal snap rings (fig. 274) using snap ring pliers and install them in the recesses of the bearing bracket. Tap the two ball bearings into the bearing bracket, screw the 5/16-inch collar

on the ballistic correction differential shaft until it moves off the threads. Slide it as far as possible on the shaft.

*g.* Slide the spur pinion on the shaft and secure it by driving a No. 6/0 x 7/16-inch taper pin through the spur pinion and the shaft (par. 59*b*). Slide the shaft and the pinion back into the bearing bracket until the pinion is in position in the bracket.

*h.* Screw the 5/16-inch collar on the shaft and secure the collar by driving a No. 4/0 x 5/8-inch taper pin through the collar and shaft.

*i.* Ease the shaft through the hole in the main bracket until the spur pinion clears the spider assembly; then slide the pinion on the spider assembly until the drilled and threaded holes of the brackets are alined.

*j.* Drive the two 1/8 x 5/8 straight pins through the drilled holes of both brackets, secure the brackets with the two No. 10 x 3/4 fillister-head screws and two No. 10 lock washers.

*k.* Tap the ball bearing (fig. 273) into the bracket. Slide the external snap ring on the shaft. Slide the bevel pinion on the shaft and secure it with one No. 6/0 x 1/2-inch taper pin through the pinion and the shaft.

*l.* Compress the two internal snap rings (fig. 272) using snap ring pliers and install them in the recesses in the bracket. Tap the two ball bearings into the bracket.

*m.* Position the bevel gear in front of the bearing in the bracket and with its teeth meshed with the teeth of the assembled bevel, pinion, insert the shaft through the bracket and the bevel gear.

*n.* Secure the gear to the shaft by driving a No. 4/0 x 5/8-inch taper pin through the pinion and the shaft. Slide the spur gear on the shaft and secure it with a No. 6/0 x 1/2-inch taper pin through the gear and the shaft.

*o.* Tap the two ball bearings (figs. 270 and 271) into the bracket, position the bevel gear (fig. 271) in front of one bearing, meshing its teeth with the teeth of the assembled bevel pinion. Position the 5/16-inch collar in front of the other bearing and insert the ammo input shaft through the bearing, the collar, the bevel gear, and the other bearing respectively.

*p.* Screw the 5/16-inch collar on the shaft, secure it by driving a No. 4/0 x 5/8-inch taper pin through the collar and the shaft. Secure the bevel gear to the shaft by driving a No. 4/0 x 5/8-inch taper pin through the gear and the shaft.

*q.* Compress the internal snap rings (figs. 270 and 271) with snap ring pliers and install in the recesses in the bracket.

*r.* Slide the spur gear (fig. 271) on the shaft and secure it by driving a No. 6/0 x 1/2-inch taper pin through the gear and the shaft.

*s.* Tap the 1/16 x 1/4 woodruff key (fig. 270) into the recess in the shaft. Slide the spur pinion on the shaft and secure it by driving a No. 6/0 x 1/2-inch taper pin through the gear and the shaft.

## 238. Assembly of Range Shaft Assembly

*a.* Inspect the range shaft and tube and gear assembly for any distortion and blow out, using air pressure to remove any dirt or metal particles. Apply grease (par. 65*a* and *b*) to the teeth of all gears and to all ball bearings before assembling.

*b.* Compress one internal snap ring (fig. 269) using snap ring pliers and install it in the recess in the tube and gear assembly. Tap a ball bearing into the same end of the tube and gear assembly and slide the range shaft into the tube and gear assembly.

*c.* Compress the other snap ring using snap ring pliers and install it in the recess in the other end of the tube and gear assembly and tap the other ball bearing into the tube.

*d.* Tap the two ball bearings (fig. 268) into the 90-tooth spur gear, slide the spur gear and the plain washer on the 1/4 x 1 21/32 slotted stud and screw the stud into the bracket.

*e.* Compress the two internal snap rings (fig. 267) with snap ring pliers and install them in the inner recesses of the right range shaft support bracket.

*f.* Tap the two ball bearings into the bracket and insert the other two retaining internal snap rings in the outer recesses of the bracket. Slide the bracket on the range shaft.

*g.* Tap the 1/16 x 1/4 woodruff key into the recess in the shaft. Slide the spur gear on the shaft and secure it by driving a No. 4/0 x 1/2-inch taper pin through the gear and the shaft.

*h.* Slide the collar on the shaft (fig. 266), secure it by driving a No. 4/0 x 3/4-inch taper pin through the collar and the shaft. Tap the 1/16 x 1/4 woodruff key into the recess of the shaft, and slide the spur gear on the shaft and secure with a No. 4/0 x 3/4-inch taper pin through the gear and the shaft.

*i.* Compress the two internal snap rings (fig. 265) with snap ring pliers and install them in the recesses in the left range shaft support bracket. Tap the two ball bearings into the bracket, slide the bracket on the shaft, slide the collar on the shaft, and secure it to the shaft by driving a No. 4/0 x 3/4-inch taper pin through the collar and the shaft.

## 239. Assembly of Superelevation Differential Assembly

*a.* To assemble the superelevation differential spider assembly, follow the same procedure as outlined in the assembly of the ballistic correction differential spider assembly, paragraph 237*b*, except that the two rings are used instead of a ring gear and a ring (fig. 264).

*b.* Tap the two ball bearings (fig. 263) into the spider brackets. Compress the two internal snap rings using snap ring pliers and install them in the recesses in the bracket.

*c.* Tap a 1/16 x 1/2 woodruff key into the superelevation differential spider assembly and slide the 66- and 36-tooth spur gear on the other end of the spider assembly. Slide the 44- and 36-tooth spur gear on the spider assembly.

*d.* Slide the spider brackets on the spider assembly, line up the drilled and the threaded holes of the brackets, and drive two 1/8 x 1/2 straight pins through the spider brackets.

*e.* Secure the brackets with two No. 10 x 5/8 fillister-head screws and two No. 10 lock washers. Slide the spur pinion on the spider assembly and secure it by driving a No. 4/0 x 1 1/16-inch taper pin through the pinion and spider assembly.

## 240. Assembly of Superelevation Mechanism Assembly

*a.* Apply grease (par. 65*a* and *b*) to the teeth of all gears and to all ball bearings before assembling. Check to see that the gears mesh properly and do not show worn or damaged teeth. Clean all parts before assembly (par. 63).

*b.* Assemble the lower bracket assembly as described in (1) through (15) below.

(1) Tap the ball bearing (fig. 262) into the lower bracket. Hold the bevel pinion in position in front of the ball bearing in the bracket and insert the crown gear drive shaft through the hole in the bracket, the bevel pinion and the bearing respectively. Then slide the other ball bearing over the shaft and tap it into the bracket.

(2) Secure the bevel pinion to the shaft by driving a No. 4/0 x 5/8-inch taper pin (par. 59*b*) through the pinion and the shaft. Screw the retaining ring into the bracket using an improvised 5/8-inch tubular wrench (fig. 57) and secure the ring with a No. 2 x 3/16 cone-point headless set screw through the bracket.

(3) Tap a 1/16 x 1/4 woodruff key into the recess in the shaft. Slide the spur gear on the shaft and secure the gear with a No. 6/0 x 1/2-inch taper pin. Tap a 1/16 x 3/8 split cotter pin through the shaft and spread the prongs.

(4) To assemble the component gears, drive a 1/8 x 5/16 straight pin (fig. 261) into the drilled hole of the noncircular gear. Position the bevel gear on the pin and secure the gears with two No. 5 x 1/4 fillister-head screws and two No. 5 lock washers.

(5) Compress the two internal snap rings (fig. 261) with snap ring pliers and install them in the recesses of the lower

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bracket. Tap the two ball bearings into the lower bracket and slide the crown gear shaft into the bracket.

(6) Screw the ¼-inch collar on the shaft, secure it to the shaft by driving a No. 6/0 x ½-inch taper pin through the collar and the shaft. Slide the component gears on the shaft and secure them by driving a No. 4/0 x ⅝-inch taper pin through the gear and the shaft.

(7) To assemble the component gears (fig. 260), follow the same procedure as described in (4) above using a spur gear in place of a bevel gear.

(8) Compress the two internal snap rings with snap ring pliers and install them in the recesses of the lower bracket. Tap the two ball bearings into the bracket. Slide the component gears on the synchro drive shaft and secure them to the shaft with a No. 6/0 x 5/16-inch taper pin through the spur gear and the shaft.

(9) Insert the shaft with the assembled component gears into the bracket. Screw the ¼-inch collar on the shaft and secure it with a No. 6/0 x ½-inch taper pin through the collar and the shaft.

(10) To assemble the superelevation differential spider assembly (fig. 259), follow the same procedure as described in paragraph 237*b* except that two rings and a superelevation differential spider are used in place of one ring and a ring gear, and a ballistic correction differential spider.

(11) Slide the 66- and 36-tooth spur gear and the 44- and 36-tooth spur gear (fig. 258) on the superelevation differential spider assembly. Slide the collar on the spider assembly and secure it with a No. 6/0 x ⅝-inch taper pin through the collar and the shaft.

(12) Tap the ball bearing (fig. 257) into the left opening of the lower bracket. Compress the internal snap ring with snap ring pliers and install it in the recess in the bracket.

(13) Ease the superelevation differential spider assembly with the two spur gears and the collar through the other bracket opening and draw it back, sliding the spider assembly into the ball bearing in the bracket.

(14) Slide the other ball bearing on the spider assembly and tap it into the bracket. Screw the retaining ring into the bracket using an improvised ⅝-inch tubular wrench (fig. 57) and secure it with a No. 2 x 3/16 cone-point set screw through the bracket.

(15) Slide the 52-tooth spur gear on the spider assembly and secure it with a No. 6/0 x ½-inch taper pin through the gear and the spider assembly.

*c.* Assemble the upper bracket assembly as described in (1) through (5) below.

(1) Position the twelve male contact plug (fig. 256) on the upper bracket and secure it to the bracket with two No. 6 hex nuts and lock washers.

(2) Solder the five taped No. 18 AWG single conductor wires (fig. 255) with markers and terminals to the plug.

(3) Slide the spacer, the washer, and the spur gear on the synchro torque transmitter and secure them to the transmitter with a No. 10 x ⅛ slotted round nut.

(4) Position the transmitter and the three synchro transmitter mounting clamps on the upper bracket, lining up the drilled holes of the clamp with the threaded holes of the bracket. Secure the clamps with three No. 5 x ⅜ fillister-head screws and three No. 5 lockwashers.

(5) Attach the five wire terminals to the transmitter with the five screws and five washers.

*d.* To assemble the lower bracket assembly to the upper bracket assembly, drive the two ⅛ x ½ straight pins (fig. 254) into the drilled holes in the lower bracket assembly. Position and secure the upper bracket assembly to the lower bracket assembly with two No. 10 x ½ fillister-head screws and two No. 10 lock washers.

## 241. Assembly of Neutral Filter Assembly

*a.* Apply grease (par. 65*a* and *b*) to the ball bearings and tap one ball bearing (fig. 253) into the neutral filter housing. Slide the shaft into the housing and tap the other bearing into the housing. Screw the retaining ring into the housing using an improvised ⅝-inch tubular wrench (fig. 57) and secure it with a No. 2 x ⅛ cone-point set screw through the housing.

*b.* Apply grease to the miter gear, slide the miter gear on the shaft, and secure it by driving a No. 6/0 x ½-inch taper pin through the gear and shaft (par. 59*b*).

*c.* Position the miter gear (fig. 252) and the collar in the neutral filter housing, meshing the teeth of the gear with the teeth of the assembled miter gear and insert the shaft through the housing, the collar, and the gear.

*d.* Secure the gear and the collar to the shaft by driving one No. 6/0 x ½-inch taper pin through the gear and the shaft and another taper pin through the collar and the shaft.

*e.* Slide one plain washer, one spring washer, and one plain washer on the shaft. Slide the neutral filter holder on the shaft positioning the drilled hole with the drilled hole in the shaft and secure it to the shaft with a No. 6/0 x ½ taper pin.

*f.* Position the neutral filter (fig. 251) in the neutral filter holder and screw in the retaining ring using 41–W–3726–195 tubular wrench until the filter is held firmly in the holder.

*g.* Secure the retaining ring to the holder with a No. 2 x 1/8 cone-point set screw.

## 242. Assembly of Compensator Assembly

*a.* Carefully check the condition of the optical elements (par. 230*e*) and replace any element that is pitted or scratched. Refer to paragraphs 61*e* and *f* for the cementing or coating of optics. If the retaining ring threads are stripped, chase threads. After chasing, if the threads are not serviceable, replace the retaining ring. Be sure when assembling the optical elements that they are properly positioned by observing the identification markings made during the disassembly. Check the gear teeth for wear and remove any burs (par. 55*e*). Apply grease (par. 65*a* and *b*) to the teeth of all gears and to all ball bearings before assembling.

*b.* To assemble the compensator lens holder assembly, screw the screw (fig. 250) into the compensator lens holder and place the compensator lens (fig. 249) in the holder. Using a small brush, apply oil resistant synthetic rubber cement to the corners of the compensator lens gasket. Line up the gasket and the compensator lens retainer holes and secure them to the holder with three No. 2 x 3/8 fillister-head screws and three No. 2 lock washers.

*c.* Slide the bevel pinion (fig. 248) on the screw of the compensator lens holder assembly and secure it by driving a No. 6/0 x 1/2-inch taper pin through the pinion and the screw (par. 59*b*).

*d.* Ease the holder assembly with the assembled pinion into the compensator housing with the screw in the housing opening. Slide the two ball bearings on the screw and tap them into the housing.

*e.* Compress the internal snap ring with snap ring pliers, and install in the recess in the housing.

*f.* Screw the retaining ring into the compensator housing using tubular wrench 41–W–3726–40 and secure the retaining ring with a No. 2 x 3/32 cone-point set screw.

*g.* Position the holder guide on housing (fig. 247), line up the holes, and secure it to the housing with two No. 5 x 5/8 fillister-head screws and No. 5 lock washers.

*h.* Slide the two ball bearings (fig. 246) on the compensator drive shaft and tap the shaft and bearings into the housing.

*i.* Tap a 1/16 x 1/4 woodruff key into the recess in the shaft and secure the bevel gear to the shaft by driving a No. 6/0 x 1/2-inch taper pin through the gear and the shaft.

*j.* Screw the retaining ring into the housing using an improvised 5/8-inch tubular wrench (fig. 57) and secure it with a No. 2 x 3/32 cone-point set screw.

*k.* Slide the spur pinion on the shaft and secure it with a No. 6/0 x 7/16-inch taper pin through the gear and the shaft.

*l.* Insert the neutral filter holder shaft (fig. 245) through the hole in the housing and slide the bevel pinion on the shaft.

*Note.*—Do not secure the pinion to the shaft with a taper pin at this time.

*m.* Slide the plain washer, a spring washer, a plain washer, and the neutral filter holder on the shaft in this order, and secure the holder to the shaft by driving a No. 6/0 x 1/2-inch taper pin through the holder and the shaft.

*n.* Tap the two ball bearings (fig. 244) into the holes in the housing and tap a 1/16 x 1/4 woodruff key into the recess in the shaft. Slide the bevel gear on the shaft and secure it with an external snap ring.

*o.* Insert the shaft with the bevel gear into the housing. Mesh the teeth of the gear and the bevel pinion and secure the bevel pinion to the shaft with a No. 6/0 x 1/2-inch taper pin (fig. 245).

*p.* Slide the coupling (fig. 244) on the shaft and secure it to the shaft by driving a No. 6/0 x 1/2-inch taper pin through the coupling and the shaft.

*q.* Tap the ball bearing (fig. 243) into the housing. Compress an internal snap ring with snap ring pliers and install in the recess in the housing.

*r.* Position the bevel pinion in the housing with its teeth meshed with the teeth of the assembled pinion and insert the filter rotating shaft through the housing and the bevel pinion.

*s.* Tap the other ball bearing into the housing. Screw in the retaining ring using tubular wrench 41–W–3726–40 and secure it with a No. 2 x 3/32 cone-point set screw through the housing. Secure the bevel pinion to the shaft with the No. 6/0 x 1/2-inch taper pin.

*t.* Clean the compensator lens (par. 63) carefully, and position it into the compensator housing (fig. 242) as indicated by the identification markings. Screw in the retaining ring using tubular wrench 41–W–3726–195 to hold the lens and secure the ring with a No. 2 x 5/32 cone-point set screw through the housing.

*u.* Using the hand injection sealing gun FO22–7648117 and adapter (fig. 11), inject adhesive sealing compound 52–C–3257–220 (par. 67) into the sealing ports to seal the compensator lens in the compensator housing (pars. 66 and 67). Screw two No. 5 x 1/8 flat-point set screws into the sealing ports.

*v.* Insert the neutral filter (fig. 241) in the neutral filter holder. Screw in the retaining ring to hold the filter firmly in the holder, using tubular wrench 41–W–3726–195. Secure it with a No. 2 x 5/32 cone-point set screw through the holder.

### 243. Assembly of Filter Shaft Assembly

*a.* Inspect the filter shaft for any distortion, slide the coupling on the shaft (fig. 240) and secure it with a No. 6/0 x 7/16-inch taper pin (par. 59*b*) through the coupling and shaft.

*b.* Slide the actuating filter shaft support on the shaft. Slide the other coupling on the other end of the shaft and secure it with a No. 6/0 x 7/16 taper pin through the coupling and the shaft.

### 244. Assembly of Left Penta Reflector Assembly

*a.* Carefully inspect the penta reflector (par. 230*e*).

*b.* Slide the compression spring (fig. 239) on the penta reflector bracket. Position the bracket on the penta reflector and drive the straight pin through the penta reflector and the bracket.

*c.* Secure the compression spring to the bracket and the penta reflector with a 1/4 x 7/8 fillister-head screw and a spherical washer. Secure the straight pin with two No. 5 x 1/8 flat-point set screws through the penta reflector.

### 245. Assembly of Right Penta Reflector Assembly

Follow the same procedure as explained in the assembly of the left penta reflector (fig. 238), paragraph 244 above.

### 246. Assembly of Sealing Window Cell Assembly

*a.* Apply oil resistant synthetic rubber cement to the gasket (fig. 235) and position it in the recess in the sealing window cell.

*b.* Carefully inspect the main housing sealing window (par. 230*e*), position it in the sealing window cell and screw the retaining ring into the cell using tubular wrench 41–W–3726–330. Seal the window in the position by injecting noncuring sealing compound 52–C–3258–500 (pars. 66 and 68) into the cell through the injection sealing ports using the hydraulic injection gun J022–7648134 and adapter (fig. 12). Insert the four No. 10 x 3/16 flat point set screws in the sealing ports. Screw in the two No. 10 x 3/8 flat-point set screws.

### 247. Assembly of Left Bearing Assembly

*a.* Insert the felt seal (fig. 234) in the left bearing housing. Apply grease (pars. 65*a* and *b*) to the ball bearing and tap it into the housing. Insert the other felt seal in the housing.

*b.* Using the improvised main bearing wrench 7662086 (fig. 50) screw the retainer (fig. 234) into the housing to secure the bearing.

*c.* Screw the No. 10 x 3/8 cone-point set screw into the housing.

### 248. Assembly of Right Bearing Assembly

*a.* Place the bearing pawl (fig. 236) on the right bearing housing and secure it to the housing with a 5/16 x 1.31 flat-fillister-head screw through the bearing pawl.

*b.* Slide the compression spring on the pawl locking plunger and insert the plunger through the opening in the housing to engage the pawl.

*c.* Drive a 7/32 x 9/16 straight pin through the pawl and plunger and secure it by driving a No. 6/0 x 7/16-inch taper pin through the plunger and the pawl (par. 59*b*).

*d.* Continue the assembly following the same procedure as explained in paragraph 247 (fig. 237).

## 249. Assembly of Filter Lever Assembly

*a.* Tap the two 1/16 x 1/4 woodruff keys (fig. 233) into the shaft.

*b.* Insert the compression spring in the plunger and slide the plunger on the shaft.

*c.* Slide the stop on the shaft and secure it to the shaft by driving a No. 5/0 x 5/8-inch taper pin through the stop and the shaft (par. 59*b*).

*d.* Insert the assembled shaft through the filter lever adapter and the filter lever and secure the lever to the shaft by driving a No. 4/0 x 15/16-inch taper pin through the lever and the shaft.

*e.* Prepare the parts for sealing (par. 66). Use the hand injection gun J022–7648117 and the adapter (fig. 11) to inject noncuring sealing compound 52–C–3258–505 (par. 69) into the injection sealing ports. Screw the two No. 10 x 1/8 flat-point set screws into the ports.

## 250. Assembly of Adapter Plate Assembly

*a.* Using an ohmmeter, check the rheostat for resistance which should range from 0 to 25 ohms (100 watts, 25 ohms, and 2.00 amps). Check the rotary switch for continuity. Check to see that the gears mesh properly and do not show worn or damaged teeth. Clean all parts before assembly (par. 63). Apply grease (par. 65*a* and *b*) to the teeth of all gears and to all ball bearings before assembling.

*b.* Screw the strap and the nut (fig. 232) on the rheostat. Slide the shaft into the rheostat and secure it by driving a No. 6/0 x 3/8-inch taper pin through the rheostat and the shaft (par. 59*b*).

*c.* Position the rheostat and the assembled parts on the adapter plate, sliding the shaft through the drilled hole in the plate, and secure the strap to the plate with four No. 5 x 5/16 fillister-head screws.

*d.* Insert the rotary switch into the plate and secure it to the plate with two No. 10 x 1 3/8 fillister-head screws and two No. 10 lockwashers.

*e.* Solder two No. 18 AWG single conductor wires with terminals (fig. 231) to the switch and one to the rheostat. Solder one wire from the rheostat to the switch (par. 64).

*f.* Position the stereo scale knob (fig. 230) on the rotary switch, which was inserted through the plate, and secure it to the switch with a No. 6/0 x 9/16-inch taper pin driven through the knob and the switch.

*g.* Position the fluted rheostat knob on the rheostat, which was inserted through the plate, and secure it with a No. 4/0 x 5/16-inch taper pin driven through the knob and the rheostat.

*h.* Prepare the parts for sealing (par. 66) and using the hand injection gun J022–7648117 and adapter (fig. 11), inject noncuring sealing compound 52–C–3258–505 (par. 69) into the sealing ports in the plate. Screw the four No. 5 x 1/8 flat point set screws into the sealing ports.

*i.* Drive two 1/8 x 5/16 straight pins (figs. 229 and 228) into the adapter plate.

*j.* Place the adapter ring on the plate, positioning it on the straight pin. Insert the elevation and azimuth knobs stop into the adapter ring and secure it to the plate with the three No. 5 x 5/16 fillister-head screws. Insert the stop ring over the knob stop in the adapter ring.

*k.* Slide the elevation and azimuth knob shaft through the hex azimuth knob and one through the fluted elevation knob and insert a compression spring and a 3/16-inch diameter ball into each knob.

*l.* Inspect markings on the scales for wear and legibility (par. 71) and slide a scale over each knob and slide the shafts through the adapter plate.

*m.* Secure each knob to the shaft with a No. 10 x 3/8 cup-point set screw.

*n.* Slide the lever locking cam (fig. 227) through the plate, screw the pivot screw into the plate, and slide the locking band over the screw with the loop of the band around the shaft.

*o.* Slide the elevation and azimuth knobs drive adapter on the shaft springing the band around the adapter. Secure the adapter with a No. 10 x 1/8 flat-point set screw and drive a No. 6/0 x 1/2-inch taper pin through the adapter and the shaft.

*p.* Drive a 1/8 x 1/2 drive pin into the adapter.

*q.* Drive a 1/8 x 3/8 straight pin (fig. 226) into the adapter plate and tap the ball bearing into the plate.

*r.* Slide the bearing and the spacer on the ammo knob shaft. Secure them by driving a 5/32 x 5/8 straight pin through the shaft and tap the ammo knob shaft and the assembled parts into the plate.

*s.* Locate the clutch on the adapter plate with the straight pin and secure it with three No. 5 x 5/16 fillister-head screws and No. 5 lock washers.

*t.* Slide the locking gear (fig. 225), compression spring, and two plain washers on the shaft.

*u.* Slide a No. 8 lock washer, a plain washer, and another lock washer on a No. 8 x 3/8 fillister-head screw and screw it into the shaft to hold the gear, the spring, and the washers.

*v.* Drive a stop pin into the plate (fig. 224), rivet the end, slide the correction knob detent on the shaft and secure it to the shaft with a No. 5/0 x ¾-inch taper pin.

*w.* Using the hand injection gun, J022–7648117 and the adapter (fig. 11), inject noncuring sealing compound 52–C–3258–505 into the injection sealing ports in the plate. Insert the two No. 5 x ⅛ flat-point set screws in the ports.

*x.* Slide the fluted ammo knob on the detent and the plate, screw the 5/16-inch slotted round nut on the shaft, and screw a No. 8 x ⅜ fillister-head screw into the shaft. Secure the knob to the nut with a No. 5 x ¼ cone-point set screw through the knob.

### 251. Assembly of Lower Front Control Panel Assembly

Insert the four pin stops (fig. 223) in the lower front control panel and rivet the ends.

### 252. Assembly of Scale Transfer Prism Lever Assembly

*a.* Apply grease (par. 65 *a* and *b*) to the ball bearing (fig. 221) and tap the bearing, the spacer, and the other ball bearing into the lever housing. Tap the 1/16 x ¼ woodruff key into the arm and insert the arm through the housing.

*b.* Slide the prism lever on the arm and drive a No. 4/0 x ¾-inch taper pin through the lever and the arm (par. 59*b*).

*c.* Prepare the parts for sealing (par. 66) and using the hand injection gun J022–7648117 and the adapter (fig. 11), inject noncuring sealing compound 52–C–3258–505 (par. 69) into the injection sealing ports. Screw the two No. 5 x ⅛ flat-point set screws into the ports.

### 253. Assembly of Reticle Adjustment Housing Assembly

*a.* Slide the reticle adjustment shaft (fig. 222) into the reticle adjustment housing. Slide the spur pinion on the shaft and secure it with a No. 6/0 x ⅜-inch taper pin through the pinion and the shaft (par. 59*b*).

*b.* Press the reticle adjustment housing cover on the shaft.

*c.* Prepare the parts for sealing (par. 66) and using hand injection gun J022–7648117 and the adapter (fig. 11), inject noncuring sealing compound 52–C–3258–505 (par. 69) into the injection sealing port and screw a No. 5 x ⅛ flat-point set screw into the port.

### 254. Assembly of Right Reticle Lamp Housing Assembly

*a.* Position the condenser lens (fig. 220), as identified by the markings made when disassembling, in the housing and screw in the retaining ring with tubular wrench 41–W–3726–38.

*b.* Apply oil resistant synthetic rubber cement to the gasket and position the gasket in the recess of the reticle lamp housing.

*c.* Insert the sockets in the right reticle lamp housing cover and secure each with a dog-point screw.

*d.* Insert an electric lamp into each socket.

*e.* Position the lamp housing knob assembly on the housing and secure it by driving a $\frac{1}{8}$ x 1 straight pin through the housing and the knob.

*f.* Position the cover on the housing and secure it with two $\frac{1}{8}$ x $1\frac{1}{2}$ straight pins through the cover and the housing.

*g.* Using the hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the sealing port to seal the condenser lens.

## 255. Assembly of Left Reticle Lamp Housing Assembly

*a.* Position the condenser lens (fig. 219) in the housing following the disassembly identification markings, and screw the retaining ring into the housing using tubular wrench 41–W–3726–38.

*b.* Position the lamp housing knob assembly on the housing and secure it by driving a $\frac{1}{8}$ x 1 straight pin through the housing and the knob assembly.

*c.* Apply oil resistant synthetic rubber cement to the gasket and position it in the recess in the housing.

*d.* Insert the socket in the left reticle lamp housing cover, secure it with a dog-point screw, and insert an electric lamp in the socket.

*e.* Position the cover on the housing and secure it by driving a $\frac{1}{8}$ x $1\frac{3}{4}$ straight pin through the cover and the housing.

*f.* Using the hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing port to seal the condenser lens in the housing.

## 256. Assembly of Spare Lamp Box Assembly

*a.* Position the lamp housing knob assembly (fig. 218) on the spare lamp box and the torsion spring on the knob, and secure the knob by driving a $\frac{1}{8}$ x $1\frac{5}{16}$ straight pin through the box and the knob assembly.

*b.* Position the other end of the spring in the box and drive a $\frac{1}{8}$ x $1\frac{5}{16}$ straight pin through the box and the spring to secure it to the box.

*c.* Position the spare lamps nameplate on the outside of the spare lamp box cover and secure it to the cover with two $\frac{3}{32}$ x $\frac{5}{16}$ universal-head rivets.

*d.* Position the spare lamp plate on the spare lamp cover and secure it to the cover with two No. 10 x $\frac{1}{2}$ fillister-head screws and No. 10 lockwashers.

*e.* Position the cover on the box and secure it to the box by driving a $\frac{1}{8}$ x 2 straight pin through the cover and the box.

## 257. Assembly of Ballistic Correction Knob Assembly

*a.* Insert stop pin (fig. 217) through ballistic correction housing and rivet the end to secure it to the housing.

*b.* Slide one ball bearing on the threaded end of the ballistic correction shaft and the other ball bearing and spacer on the other end. Secure them by driving a 5/32 x 5/8 straight pin through the shaft. Apply grease (par. 65*a* and *b*) to the the teeth of all gears and to all ball bearings before assembling.

*c.* Tap the shaft with the assembled parts into the housing and slide the correction knob detent on the shaft, securing it with a No. 5/0 x 3/4-inch taper pin (par. 59*b*) through detent and shaft.

*d.* Drive a 1/8 x 3/8 straight pin into the housing. Position the clutch on housing, locating it on the straight pin. Secure it to the housing with three No. 5 x 5/16 fillister-head screws and No. 5 lock washers.

*e.* Slide the locking gear (fig. 216), compression spring, and two plain washers on the shaft.

*f.* Slide a plain washer and two No. 8 lock washers on a No. 8 x 3/8 fillister-head screw and screw it into the shaft to secure gear, spring, and washers to the shaft.

*g.* Using hand injection gun J022–7648117 and the adapter (fig. 11), inject noncuring sealing compound 52–C–3258–505 (par. 69) into injection sealing ports in the housing. Insert two No. 5 x 1/8 flat-point set screws into the ports (fig. 217).

*h.* Inspect the fluted ballistic correction knob (fig. 216) for wear and legibility (par. 71). Slide it on the detent and housing and screw the 5/16-inch slotted round nut on the shaft.

*i.* Secure the knob to the nut with a No. 5 x 1/4 cone-point set screw through the knob and screw the No. 8 x 3/8 fillister-head screw into the end of the shaft.

## 258. Assembly of ICS Knob Assembly

*a.* Insert the stop pin (fig. 215) in the ICS knob housing and secure it to the housing by riveting the end.

*b.* Apply grease (par. 65*a* and *b*) to the ball bearing. Tap the ball bearing into the housing and slide the ICS knob shaft through the bearing into the housing. Slide the other bearing on the shaft and tap it into the housing.

*c.* Compress the internal snap ring using snap ring pliers and install it in the recess in the housing. Slide the spur gear on the shaft and secure it with a No. 4/0 x 5/8-inch taper pin (par. 59*b*) through the gear and the shaft.

*d.* Slide the correction knob detent (fig. 214) on the shaft, lining up the drilled holes, and secure it to the shaft by driving a No. 5/0 x 3/4-inch taper pin through the detent and the shaft.

*e.* Inspect the fluted ICS knob for wear and legibility (par. 71). Slide the knob on the detent and the housing, and screw the $\frac{5}{16}$-inch slotted round nut on the shaft. Secure the knob to the nut with a No. 5 x $\frac{1}{4}$ cone-point set screw, and screw the No. 8 x $\frac{3}{8}$ fillister-head screw into the end of the shaft.

*f.* Prepare the parts for sealing (par. 66) and using hand injection gun J022–7648117 and the adapter (fig. 11), inject noncuring sealing compound 52–C–3258–505 (par. 69) into the injection sealing ports in the housing. Screw two No. 5 x $\frac{1}{8}$ flat-point set screws into the sealing ports.

## 259. Assembly of Halving Knob Assembly

*a.* Slide the halving knob shaft (fig. 213) into the halving knob housing and insert the two stop rings in the housing. Slide the fluted halving knob on the shaft and secure the knob to the shaft by driving a No. 4/0 x $\frac{7}{8}$-inch taper pin (par. 59*b*) through the knob and the shaft.

*b.* Apply grease (par. 65*a* and *b*) to the gear teeth. Slide the gear on the other end of shaft and secure it to the shaft by driving a No. 6/0 x $\frac{1}{2}$-inch taper pin through the gear and the shaft.

*c.* Using hand injection gun J022–7648117 and the adapter (fig. 11), inject noncuring sealing compound 52–C–3258–505 (par. 69) into the injection sealing ports and screw two No. 5 x $\frac{1}{8}$ flat-point set screws into the housing.

## 260. Assembly of Lower Link Connector

*a.* Slide the 0.750 diameter eccentric stud (fig. 212) into the eccentric sleeve and secure them by driving a $\frac{3}{16}$ x $\frac{13}{16}$ straight pin through the sleeve and stud. Insert the No. 5 x $\frac{1}{8}$ cup-point set screw in the sleeve.

*Note.*—First range finders manufactured did not have the eccentric stud with sleeve. These parts will be substituted in older models when possible.

*b.* Insert the plain washer in the lower link connector and slide the assembled stud and sleeve into the connector.

*c.* Apply grease (par. 65*a* and *b*) to the ball bearings. Slide the ball bearing on the stud, tap it into the connector, slide the spacer on the stud, and tap the other ball bearing into the connector.

*d.* Slide the ball bearing lock washer on the stud, screw the ball bearing lock nut on the stud, and bend a prong of the lock washer into the groove in the lock nut.

*e.* Screw the $1\frac{1}{4}$ x 0.50 retainer into the connector using tubular wrench 41–W–3726–113 and secure the retainer with a No. 5 x $\frac{3}{16}$ cone-point set screw through the connector.

## 261. Assembly of Upper Link Connector Assembly

*a.* Insert a plain washer (fig. 211) in the upper link connector. Slide the eccentric sleeve on the eccentric cam housing stud, drive the $\frac{3}{16}$ x $\frac{13}{16}$ straight pin through the drilled holes in the sleeve and the stud. Insert the No. 5 x $\frac{1}{8}$ cup-point set screw in the sleeve.

*Note.*—First range finders manufactured did not have the eccentric stud with sleeve. These parts will be substituted in older models when possible.

*b.* Apply grease (par. 65*a* and *b*) to the ball bearings. Slide a ball bearing, a spacer, another ball bearing, a spring washer, and a ball bearing lockwasher on the eccentric cam housing stud in this order.

*c.* Screw the ball bearing lock nut on the stud and press a prong of the ball bearing lockwasher into a slot of the lock nut to hold it in position.

*d.* Tap stud with the assembled parts into the connector and screw the $1\frac{3}{4}$ x 0.57 retainer into the connector to hold the stud in position using an improvised $1\frac{11}{16}$-inch pin-type spanner wrench (fig. 54). Secure the retainer with a No. 5 x $\frac{1}{4}$ flat-point set screw through the connector.

## 262. Assembly of End Housing Assembly

*a.* Carefully check the condition of the optical elements (par. 230*e*) and replace any element that is pitted or scratched. Refer to paragraph 61*e* and *f* for the cementing or coating of optics. If the retaining ring threads are stripped, chase the threads. After chasing, if the threads are not serviceable, replace the retaining ring. Be sure when assembling the optical elements that they are properly positioned by observing the identification markings made during disassembly. Check the parts for cracks or abrasions and replace if the condition is detrimental. Clean the parts to eliminate any dirt or grease (par. 63).

*b.* Apply a thin film of oil (par. 65*c*) to the long and short keys; then wipe them with a clean cloth. Drive two $\frac{3}{16}$ x $\frac{1}{2}$ straight pins (fig. 210) into the end housing. Position the two long keys on the housing and secure them to the housing with four No. 6 x $\frac{1}{2}$ socket-head cap screws and four No. 6 lockwashers.

*c.* Position the two short keys on the housing and secure them to the housing with two $\frac{1}{4}$ x $\frac{1}{2}$ socket-head cap screws and two $\frac{1}{4}$-inch lockwashers.

*d.* Assemble the azimuth correction cell assembly as described in (1) and (2) below.

(1) Insert the azimuth correction wedge (fig. 209) in the azimuth correction wedge cell in the position as identified by the marking on the wedge made in disassembly.

(2) Screw the retaining ring into the cell using tubular wrench 41–W–3726–285.

(3) Using the hydraulic injection gun, J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the sealing ports in the cell.

*e.* Install the cycle valve and valve cap as described in (1) and (2) below.

(1) Slide the rubber washer (fig. 207) on the cycle valve, insert the valve through the housing from the inside, slide the two washers on the valve, and screw the nut on the valve.

(2) Screw the valve cap on the cycle valve using the improvised desiccation valve wrench (fig. 47).

*Note.*—Sealing compound is not injected into the cap sealing ports until after the end housing pressure tests and nitrogen gas charging.

*f.* Install the azimuth correction cell assembly as described in (1) and (2) below.

(1) Insert the azimuth correction cell assembly into the end housing using the improvised cell assembly wrench (fig. 208) and secure the cell assembly loosely in the housing with four No. 10 x 3/8 flat-point set screws (fig. 207).

*Note.*—The cell assembly is adjusted by the set screws during adjustment on the interferometer.

(2) Insert four No. 10 x 3/16 flat-point set screws loosely in the sealing ports in the housing.

*g.* Assemble the end housing cover assembly as described in (1) through (3).

(1) Slide the compression spring (fig. 206) on the penta reflector. Position the penta reflector on the end housing cover and secure it to the cover by driving a 0.2499 x 1 11/16 straight pin through the cover and the reflector.

(2) Slide a spherical washer on the fillister-head screw, insert the screw through the cover and the spring, and screw it into the reflector. Drive a spring pin through the screw.

(3) Secure a 0.2499 x 1 11/16 straight pin to the cover with two No. 5 x 1/8 flat-point set screws through the cover to the pin. Secure the reflector to the straight pin with two No. 5 x 1/8 flat-point set screws through the reflector to the pin.

*h.* Position the end housing cover assembly (fig. 205) on the end housing and secure it to the housing with six No. 10 x 5/8 fillister-head screws and No. 10 lockwashers.

*i.* Insert four No. 10 x 3/16 flat-point set screws loosely in the injection sealing ports in the housing.

*j.* Position the end housing window in the end housing referring to the identification markings made in disassembly.

*k.* Screw the retaining ring into the housing using tubular wrench 41–W–3726–285.

*l.* Screw the slotted plug into the housing using tubular wrench 41–W–3726–98. Insert two No. 10 x $\frac{3}{16}$ flat-point set screws loosely into the injection sealing ports in the plug.

*Note.*—The loosely inserted set screws are removed and sealing compound injected after the interferometer adjustment.

## 263. Adjusting End Housing Assembly on Interferometer

*a. Mounting End Housing.*

(1) Place the end housing assembly on the interferometer as shown in figure 298.

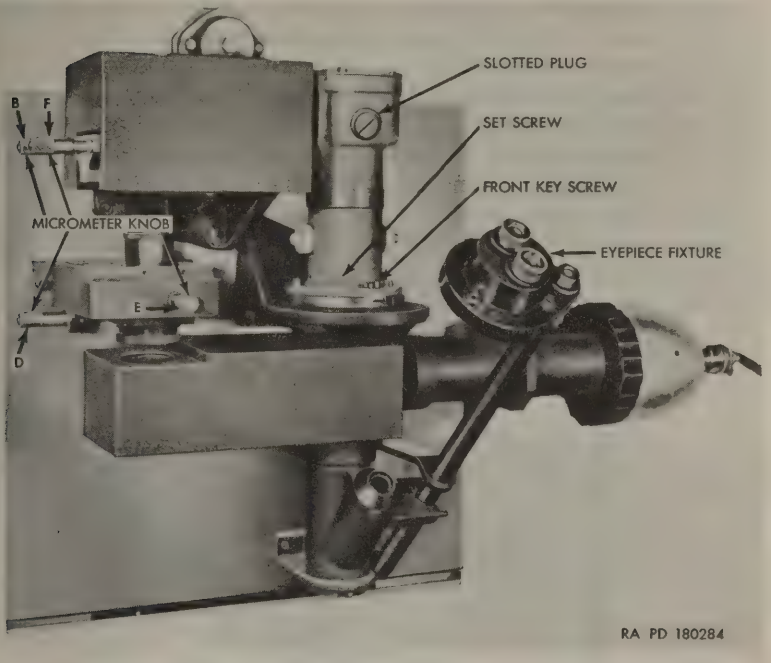


*Figure 298. Adjusting end housing assembly on interferometer.*

(2) Tighten the front and back key screws snugly.

(3) Place three socket-head cap screws in alternate holes in the seating ring and tighten snugly.

*b. Image Rotation and Base Length.*

(1) Move the eyepiece fixture to the position shown and turn on the light source.

(2) Look in the upper eyepiece of the fixture and adjust the micrometer knob F until the pointer is superimposed on the line. Read the front base length from the micrometer and record the deviation from nominal.

*Note.*—*Each* interferometer is marked with a nominal value.

(3) Look in the lower eyepiece and adjust micrometer knob B until the pointer is superimposed on the line. Read the rear base length from the micrometer and record the deviation from nominal.

(4) The maximum allowable difference between front and rear base length is 0.002 inch (5 min.).

(5) If the difference is greater than 0.002 inch, loosen the six No. 10 x 5/8 fillister-head screws in the end housing cover assembly and rotate the cover slightly. Tighten the screws and again check the base length. A very slight change in the position of the end housing cover assembly is usually sufficient to bring the base length within tolerance.

*c. Horizontal Deviation.*

(1) Remove the end housing from the interferometer.

(2) Insert the two pegs of the adapter (fig. 299) in the two holes in the azimuth correction cell assembly (fig. 207). Place the adapter and end housing in the interferometer.

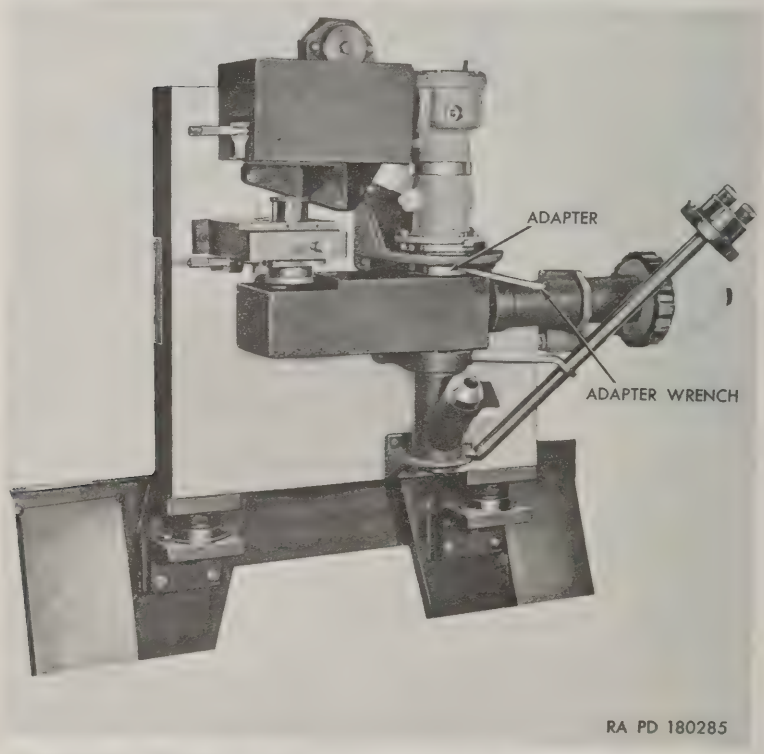


*Figure 299. Adjusting end housing assembly for horizontal deviation and elevation.*

(3) Loosen the two set screws (fig. 298). Turn off the light and move the eyepiece fixture to the position shown in figure 299.
(4) Set micrometer knob E (fig. 298) to read 0.015 inch or 0.020 inch either way from nominal.
(5) Set micrometer knob D to nominal reading.
(6) While looking through the lower eyepiece, rotate the cell assembly by means of the adapter wrench until the fringes (indistinct parallel lines) are horizontal. Tighten the set screws.

*d. Elevation.*

(1) Set micrometer knob D to read 0.015 or 0.020 inch either way from nominal.
(2) Set micrometer knob E to nominal reading.
(3) Remove the slotted plug (fig. 298) using tubular wrench 41–W–3726–98, and turn the exposed screw until the fringe area is vertical.
(4) Replace the slotted plug and tighten the screws.
(5) Remove the two set screws that had been inserted loosely in the plug (fig. 205), and using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing ports. Again insert the set screws.

## 264. Pressure Test of End Housing Assembly

*a. To Charge.*

(1) Open upper stop cocks (fig. 300).
(2) Close lower stop cocks.
(3) Close the pinch cocks.
(4) Connect the threaded couplers to the end housing assemblies and connect the snap-on coupler to the regulated charging line.
(5) Set the charging line pressure to about 5 pounds per square inch.
(6) Carefully open the lower stop cock and allow the pressure to rise to 3.5 pounds per square inch on the mercury manometer.
(7) Disconnect the charging line.

*b. To Test.*

(1) Not less than 15 minutes after opening the lower stop cock, close the upper stop cock.
(2) Allow 12 hours for the test; then read the pressure loss on the butyl phthalate manometer. Pressure loss should not exceed 0.15 pounds per square inch.

*c. To Discharge.*

(1) Open the upper stop cocks.
(2) Slowly bleed the air from the pinch cocks.

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*Figure 300. Pressure test of end housing assembly.*

(3) Disconnect the threaded couplers from the end housing assemblies.

*Note.*—Small variations in temperature between the end housing assemblies and the glass jugs beneath the test stand will cause a temporary change in the pressure reading on the butyl phthalate manometer. Such variations can be caused by body temperature or uneven air circulation. Care should be taken to avoid such changes, particularly before proceeding with steps *b* (1) and (2) above.

*d.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing ports in the valve caps.

## Section III. ASSEMBLY OF COLLIMATOR ASSEMBLY

### 265. In-Process Inspection

Refer to paragraph 230 for general rebuild instructions. Refer to paragraphs 61*e* and *f* for the cementing or coating of optics. Be sure

when assembling the optical elements that they are properly positioned by observing the identification markings made during disassembly. Apply grease (par. 65*a* and *b*) to the teeth of all gears and to all ball bearings before assembling.

## 266. Assembly of Reticle Assembly

*a.* Assemble the reticle housing assembly as described in (1) and (2) below.

(1) Position the two ball bearings (fig. 204) and the four plain washers in the left reticle housing and secure them to the housing by driving two 0.1248 x 0.50 straight pins through the housing, the bearings, and the washers.

(2) Drive the two 0.1562 x ¾ straight pins into the housing and secure them in place with two 1/16 x ⅜ straight pins through the housing and ¾-inch straight pins.

*b.* Position the plate (fig. 203) on the left reticle housing assembly and secure it to the housing with two No. 5 x 5/16 fillister-head screws.

*c.* Assemble the reticle cell assembly as described in (1) and (2) below.

(1) Carefully inspect (par. 230*e*) and insert the reticle (fig. 202) in the reticle cell, referring to the identification markings made in disassembly.

(2) Screw the retaining ring into the cell using tubular wrench 41–W–3726–240. Use the hand injection gun J022–7648117 and the adapter (fig. 11) to inject adhesive sealing compound 52–C–3257–220 (par. 67) into the sealing ports in the cell.

*d.* Install the reticle cell assembly as described in (1) through (3) below.

(1) Slide the reticle cell assembly (fig. 201) into the reticle housing with the slot in the cell lined up with the opening in the reticle housing. Insert the eccentric through the housing opening and into the slot in the cell.

(2) Position the retainer on the housing, lining up the drilled holes of the retainer with the threaded holes in the housing. Secure the retainer to the housing with three No. 5 x ¼ fillister-head screws and No. 5 lock washers.

(3) Secure the reticle cell to the reticle housing by two No. 8 x ¼ cup-point set screws through the housing.

## 267. Assembly of Plunger Assemblies

Position the ball bearing (fig. 174) and the two plain washers in the slot of the plunger and drive a 0.1248 x 0.50 straight pin through the plunger, washers, and ball bearing.

## 268. Assembly of Collimator Lens Alining Assembly

*a.* Assemble the inner collimator lens cell assembly as described in (1) and (2) below.

(1) Carefully inspect (par. 230*e*), then insert the collimator lens (fig. 200) in the inner collimator lens cell referring to the identification markings made in disassembly.

(2) Screw the retaining ring into the cell using tubular wrench 41–W–3726–190. Use the hand injection gun J022–7648117 and the adapter (fig. 11) to inject adhesive sealing compound 52–C–3257–220 (par. 67) into the injection sealing ports in the cell.

*b.* Assemble the collimator lens cell assembly as described in (1) and (2) below.

(1) Carefully inspect (par. 230*e*), then insert the collimator lens (fig. 199) into the outer collimator lens cell referring to the identification markings made in disassembly.

(2) Screw the retaining ring into the cell using tubular wrench 41–W–3726–190. Inject noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing ports in the cell with the hydraulic injection gun J022–7648134 and the adapter (fig. 12).

*c.* Install inner collimator lens cell assembly as described in (1) and (2) below.

(1) Slide the inner collimator lens cell assembly (fig. 198) into the outer collimator lens cell assembly, lining up the scribed lines on each assembly.

*Note.*—In case the optics are damaged, the alining assembly is replaced with a new alined and scribed assembly.

(2) Secure the two cell assemblies with a No. 10 x $\frac{5}{32}$ cone-point set screw through the outer cell.

## 269. Assembly of Beam-Splitter Prism Assembly

*a.* Screw the clevis (fig. 197) into the prism support.

*b.* Position the retainer on the prism support, lining up the drilled hole of the retainer with the threaded holes in the support. Secure the retainer with three No. 8 x ½ fillister-head screws and No. 8 lock washers.

*c.* Carefully inspect (par 230*e*), then insert the prism in the support and fix the position of the prism by inserting a No. 8 x ⅜ cup-point set screw through the prism support.

*d.* Tap the ball bearing on the prism support.

## 270. Assembly of Beam-Splitter Stop Bracket Assembly

*a.* Screw the clevis (fig. 196) into the beam-splitter stop bracket.

*b.* Screw two $\frac{3}{8}$ x $1\frac{7}{16}$ hex-head screws into the bracket and screw two hex jam nuts on the screws.

### 271. Assembly of Horizontal Reticle Drive Bracket Assembly

*a.* Tap two ball bearings (fig. 195) into the gear bracket. Slide the bevel gear on the reticle drive vertical shaft and secure it to the shaft by driving a No. 6/0 x $\frac{3}{8}$-inch taper pin (*b* below and par. 59*b*) through the gear and shaft.

*b.* Slide the shaft through the bracket, slide the miter gear on the shaft, and secure it to the shaft with a No. 6/0 x $\frac{3}{8}$-inch taper pin.

*c.* Tap two ball bearings (fig. 194) into the gear bracket and insert the reticle drive shaft through the bracket.

*d.* Slide the 24-pinion-tooth and 48-gear-tooth bevel pinion on the shaft, meshing its teeth with those of the assembled bevel gear. Secure it to the shaft by driving a No. 6/0 x $\frac{3}{8}$-inch taper pin through the pinion and the shaft.

*e.* Slide the collar on the shaft and secure it to the shaft by driving a No. 6/0 x $\frac{3}{8}$-inch taper pin through the collar and the shaft.

*f.* Slide the 60-pinion-tooth and 78-gear-tooth bevel pinion on the shaft and secure it to the shaft with a No. 6/0 x $\frac{3}{8}$-inch taper pin.

### 272. Assembly of Beam-Splitter Rotating Bracket Assembly

*a.* Tap two ball bearings (fig. 193) into the gear bracket and insert the horizontal reticle drive shaft through the gear bracket.

*b.* Slide the miter gear on the shaft and secure it by driving a No. 6/0 x $\frac{3}{8}$-inch taper pin through the gear and the shaft (par. 59*b*).

### 273. Assembly of Correction Wedge Housing Assembly

*a.* Assemble the collimator correction wedge cell assembly as described in (1) and (2) below.

(1) Carefully inspect (par. 230*e*), then insert the collimator correction wedge (fig. 192) into the collimator correction wedge cell referring to the identification markings made in disassembly.

(2) Screw the retaining ring into the cell using tubular wrench 41–W–3726–190. Use the hand injection gun J022–7648117 and the adapter (fig. 11) to inject adhesive sealing compound 52–C–3257–220 (par. 67) into the injection sealing ports in the cell.

*b.* Assemble the correction wedge gear assembly as described in (1) and (2) below.

(1) Insert the collimator correction wedge (fig. 191) in the worm gear and screw the retaining ring into the cell using tubular wrench 41–W–3726–190.

(2) Use the hand injection gun J022–7648117 and the adapter (fig. 11) to inject adhesive sealing compound 52–C–3257–220 (par. 67) into the sealing ports in the worm gear.

*c.* Install the collimator correction wedge cell assembly and the correction wedge gear assembly as described in (1) through (4) below.

(1) Insert the collimator correction wedge cell assembly (fig. 190) in the correction wedge housing and secure it to the housing loosely with two No. 10 x 3/16 cup-point set screws.

(2) Screw the clamping ring, using an improvised 2.4-inch pin-type spanner wrench (fig. 51), into the housing. Secure it to the housing with one No. 5 x 5/32 cone-point set screw through the ring. Apply orange shellac varnish to the set screw.

(3) Insert the correction wedge gear assembly into the correction wedge housing and screw in the clamping ring using an improvised 2.4-inch pin-type spanner wrench.

(4) Secure the ring to the housing by inserting one No. 5 x 5/32 cone-point set screw through the ring and the housing.

*d.* Install the correction wedge worm and related parts as described in (1) through (6) below.

(1) Position the ball socket (fig. 189) on the correction wedge worm and insert the worm in the housing.

(2) Screw the ball cap into the housing using an improvised 3/8-inch tubular wrench (fig. 56), and secure it with a No. 2 x 1/16 flat-point set screw through the housing.

(3) Insert a No. 2 x 0.08 dog-point screw through the housing.

(4) Insert the plunger in the housing aperture.

(5) Position the flat spring in the housing recess.

(6) Position the plate on the housing and secure it to the housing with four No. 2 x 3/16 flat-head screws.

## 274. Assembly of Mirror Assembly

*a.* Position the reflecting mirror (fig. 188) in the mirror bracket.

*b.* Place two 3/16-inch diameter balls in two retainers and screw the retainers into the bracket to secure the mirror to the bracket. Stake the retainers (par. 57).

## 275. Assembly of Ammunition, Bore Sight, and Range Scale Assembly

*a.* Place the sighting guide reticle (fig. 187) on the base and secure it to the base with two No. 6 x 1/4 fillister-head screws and No. 6 lock washers. Drive two 1/16 x 1/4 straight pins through the guide into the base.

*b.* Drive two 3/32 x 3/8 straight pins (fig. 186) into the base to locate each sighting reticle bracket.

*c.* Position the right and left sighting reticle brackets on the base, locating them on the straight pins, and secure each bracket to the base with two No. 8 x 3/8 fillister-head screws and No. 8 lock washers.

*d.* Position the ammo scale over the slots in the base and secure it at each end with a No. 5 slotted stud, a washer, and a No. 5 x 1/8 hex nut.

*e.* Insert the compression spring (fig. 185) in the spur gear and slide the spur gear on the No. 10 x 6.906 lead screw.

*f.* Drive a 3/32 x 5/32 straight pin through the gear to fit in the groove in the lead screw.

*g.* Tap four ball bearings (fig. 184) into the sighting reticle brackets.

*h.* Position the sighting reticle and the range scale on the base and insert No. 10 x 6.656 lead screw and No. 10 x 6.906 lead screw through the right sighting reticle bracket.

*i.* Referring to the scribe marks made in the disassembly, engage the correct threads and screw the lead screws through the sighting reticle and the range scale until the other ends of the screws are supported by the left sighting reticle bracket.

*j.* Secure the sighting reticle and the range scale to the lead screws with two No. 2 x 3/8 flat-head screws and two No. 5 x 3/16 flat-point set screws in the reticle and the scale.

*k.* Drive two 1/16 x 1/4 straight pins (fig. 183) into the base.

*l.* Position the range scale guide on the base, locating it on the straight pins, and secure it to the base with two No. 6 x 1/4 fillister-head screws and No. 6 lock washers.

*m.* Screw the lead screw nut on the No. 10 x 6.906 lead screw and secure it to the screw with a No. 5 x 1/8 flat-point set screw.

*n.* Screw the lead screw collar on the No. 10 x 6.656 lead screw and secure it to the screw with a No. 5 x 1/8 flat-point set screw.

*o.* Drive two 1/16 x 3/16 straight pins (fig. 182) into each bracket and position the range scale and ammo indexes on the brackets, locating them with the straight pins.

*p.* Secure the indexes to the brackets with four No. 5 x 1/4 round-head screws.

*q.* Tap the four ball bearings (fig. 181) into the range and sighting reticle drive bracket. Insert the long shaft into the bracket and slide the 64-tooth spur gear on the shaft. Secure the gear to the shaft by driving a No. 6/0 x 3/8-inch taper pin through the gear and the shaft (par. 59*b*). Insert the short shaft into the bracket and slide the 36-tooth spur gear on the shaft. Secure the gear to the shaft by driving a No. 6/0 x 3/8 taper pin through the gear and the shaft.

*r.* Drive one 3/32 x 3/8 straight pin (fig. 180) into the base. Position the range and sighting reticle drive bracket assembly on the base and secure it to the base with two No. 10 x 1/2 fillister-head screws and No. 10 lock washers.

*s.* Drive two 1/16 x 1/4 straight pins into the ammo scale and position the scale rack on the pins.

*t.* Secure the scale rack to the ammo scale with two No. 5 x 3/8 fillister-head screws.

### 276. Assembly of Constant Rise Cam Assembly

*a.* Tap the two ball bearings (fig. 179) into the bracket and slide the shaft through the bracket.

*b.* Slide the constant rise cam on the shaft and secure it by driving a No. 6/0 x 1/2-inch taper pin through the cam and the shaft (par. 59*b*).

### 277. Installation of Rails

*a.* Drive two 1/16 x 3/8 straight pins (fig. 178) into the collimator housing.

*b.* Position the two rails on the straight pins and secure each rail to the housing with three No. 5 x 3/8 fillister-head screws and No. 5 lock washers.

c. Check the rails in the reticle section of the collimator housing for the specifications indicated in (1) and (2) below.

(1) Rails perpendicular to the reticle cover surface within 0.002-inch maximum. This may be checked with the aid of a perpendicularity gage.

(2) Rails parallel to each other 0.002-inch maximum. This may be checked with the aid of a vernier caliper.

### 278. Installation of the Reticle Drive Shaft and Related Parts

*a.* Slide two ball bearings (figs. 175 and 176) on each reticle drive shaft and screw a No. 5/16 x 7/8 pan-head screw into each shaft, lapping the screw threads if necessary to obtain smooth action.

*b.* Insert both the assembled shafts through the lower collimator housing apertures with the screw head slots positioned on the rail. Bearings must turn freely on the shaft.

*c.* Screw the two retaining rings into the housing using an improvised 5/8-inch tubular wrench (fig. 57).

*d.* Secure them to the housing with two No. 5 x 3/16 cone-point set screws. Apply orange shellac varnish to the screws before inserting.

*e.* Slide the spur gear on the left reticle drive shaft and secure it by driving a No. 6/0 x 1/2-inch taper pin through the gear and shaft (par. 59*b*).

*f.* Slide the bevel gear on the right reticle drive shaft and secure it by driving a No. 6/0 x 1/2-inch taper pin through the gear and shaft.

### 279. Installation of Horizontal Reticle Drive Bracket Assembly

*a.* Drive two 1/8 x 3/8 straight pins (fig. 170) into the collimator housing.

*b.* Position the horizontal reticle drive bracket assembly on the collimator housing and secure it to the housing with two No. 8 x ½ fillister-head screws and No. 8 lock washers.

### 280. Installation of Beam-Splitter Rotating Bracket Assembly and Reticle Cover

*a.* Drive two ⅛ x ⅜ straight pins (fig. 169) into the collimator housing.

*b.* Position the beam-splitter rotating bracket assembly on the housing, locating it on the straight pins. Mesh the teeth of the miter gear with those of the bevel pinion of horizontal reticle drive bracket assembly. Secure it to the housing with two No. 8 x ⅜ fillister-head screws and two No. 8 lock washers.

### 281. Installation of Beam-Splitter Prism Assembly

*a.* Clean the prism and the metal parts carefully (par. 63).

*b.* Tap the ball bearing (fig. 172) into the collimator housing.

*c.* Insert the bearing retainer in the housing and secure it with three No. 10 x ⅜ fillister-head screws and three No. 10 lock washers.

*d.* Slide the beam-splitter prism assembly through the bearing retainer.

*e.* Drive a 1/16 x ¼ woodruff key into the prism assembly.

*f.* Slide the beam-splitter actuating arm on the prism assembly and secure it with a No. 4/0 x ⅝-inch taper pin through the arm and the prism assembly (par. 59*b*).

### 282. Installation of the Beam-Splitter Stop Bracket Assembly

*a.* Drive two ¼ x 9/16 straight pins (fig. 171) into the collimator housing.

*b.* Secure the beam-splitter stop bracket assembly to the housing with four No. 10 x ½ fillister-head screws and four No. 10 lock washers.

*c.* Hook one end of the extension spring on the clevis in the bracket and the other end on the clevis in the prism assembly.

### 283. Installation of the Reticle Assembly

*a.* Screw the two clevises (fig. 177) into the collimator housing and hook an extension spring on each clevis.

*b.* Slide the right reticle assembly on the rail into the collimator housing.

*c.* Insert the plunger assembly (fig. 174) in the collimator housing in position so that the slot will engage the reticle housing assembly properly.

*d.* Insert the compression spring in the plunger and secure it by screwing the slotted cap on the threads of the collimator housing.

*e*. Using a pliers, stretch the two extension springs (fig. 177) and hook them to the right reticle assembly.

*f*. Position the reticle cover (fig. 169) on the housing and secure it loosely with four No. 8 x 5/16 fillister-head screws.

### 284. Installation of Collimator Lens Alining Assembly

*a*. Slide the two collimator lens alining assemblies (fig. 173) into the collimator housing and secure each lightly with two No. 10 x 3/8 cup-point set screws and two No. 10 x 3/16 cup-point set screws.

*b*. Apply orange shellac varnish and screw one No. 10 x 1/2 slotted stud through the collimator housing and each alining assembly.

### 285. Installation of Correction Wedge Housing Assemblies

*a*. Drive a 1/8 x 3/8 straight pin (fig. 168) into each end of the collimator housing.

*b*. Position the two correction wedge housing assemblies on the collimator housing and secure each with four No. 10 x 1/2 fillister-head screws and four No. 10 lock washers.

*c*. Slide the collar on the correction wedge worm of the left housing and secure the coller by driving a No. 6/0 x 3/8-inch taper pin through the collar and worm (par. 59*b*).

### 286. Installation of Ammunition, Bore Sight, and Range Scale Assembly

*a*. Drive two 3/16 x 3/8 straight pins (fig. 166) into the collimator housing.

*b*. Position the bore sight and range ammo scale assembly on the collimator housing, locate it on the straight pins, and secure it to the housing with four No. 10 x 1/2 fillister-head screws and four No. 10 washers.

### 287. Installation of Constant Rise Cam Assembly

*a*. Drive one 3/32 x 3/8 straight pin (fig. 166) into the base of the scale assembly.

*b*. Position the constant rise cam assembly on the scale assembly, locating it on the straight pin, and secure it to the base with two No. 8 x 3/8 fillister-head screws and two No. 8 lock washers.

### 288. Installation of 90° Prisms

Position the two 90° prisms (fig. 167) on the collimator housing and secure each prism with three No. 8 x 3/8 fillister-head screws.

### 289. Installation of Mirror Assembly

*a*. Drive two 1/8 x 3/8 straight pins (fig. 167) into the collimator housing.

*b.* Position the mirror assembly on the collimator housing, locating it on the straight pins, and secure to housing with two No. 8 x 3/8 fillister-head screws and two No. 8 lock washers.

## 290. Optical Alinement of Collimator Assembly

*a. Installation of Collimator Assembly in Collimator Alinement Fixture.* Place the collimator assembly on the collimator alinement fixture 7660850 with the machined rear mounting surfaces of the housing positioned against the rails of the fixture (fig. 301).

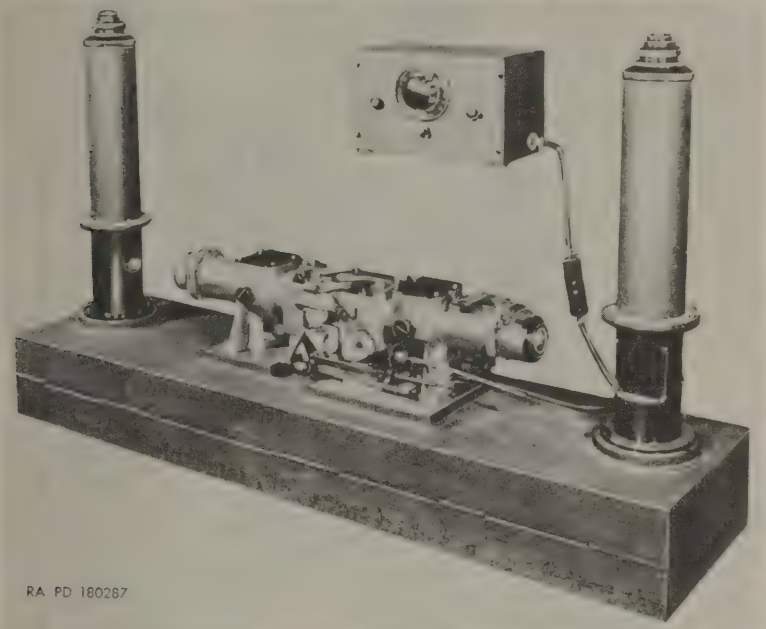


*Figure 301. Installation of collimator assembly in collimator alinement fixture.*

*b. Focusing the Collimator Lens Alining Assembly.*

(1) Loosen the two No. 10 x 3/8 cup-point set screws (fig. 302) and the two No. 10 x 3/16 cup-point set screws in the collimator housing to free the collimator lens alining assembly from the collimator housing.

(2) Using the No. 10 x 1/2 slotted stud, slide the alining assembly in the collimator housing until the sighting reticle pattern (fig. 303) appears to be in the same plane as the telescope reticles when viewed through the telescopes at either end of the fixture. The position of the eye should be moved from side to side and top to bottom of the telescope eyepiece. There must be no apparent parallax between the sighting

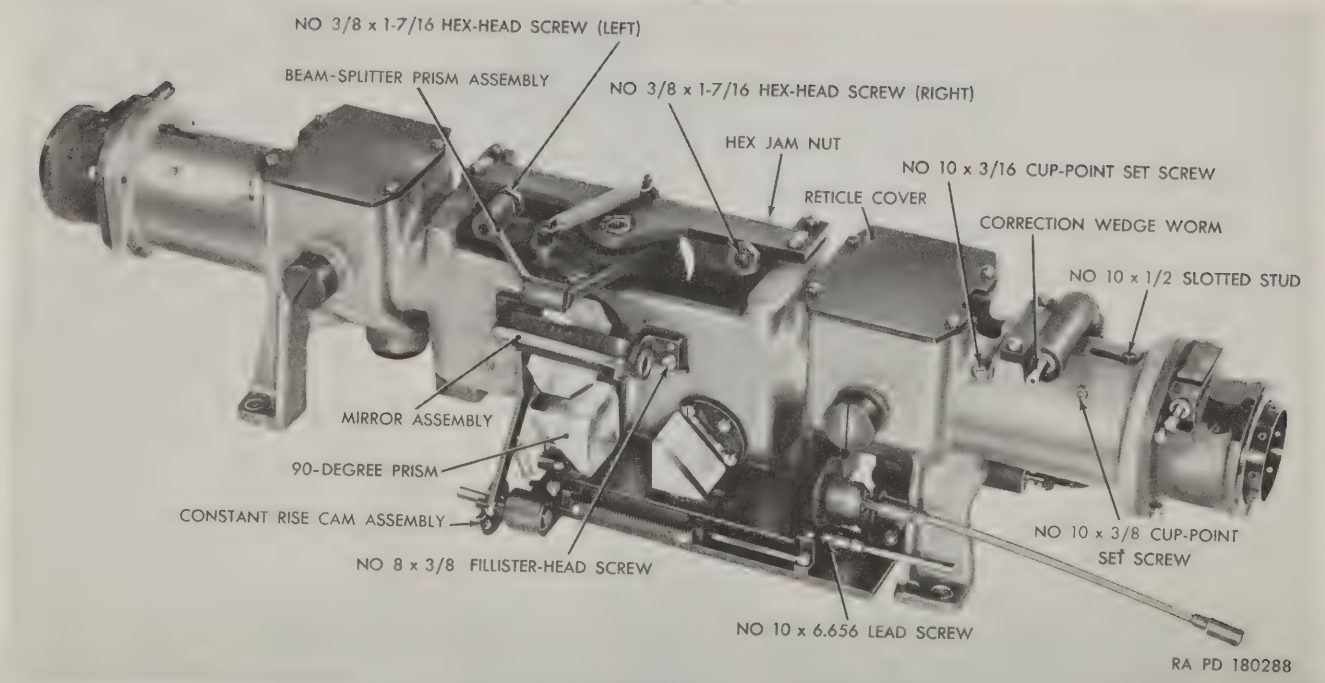
NO 3/8 x 1-7/16 HEX-HEAD SCREW (LEFT)
BEAM-SPLITTER PRISM ASSEMBLY
NO 3/8 x 1-7/16 HEX-HEAD SCREW (RIGHT)
HEX JAM NUT
NO 10 x 3/16 CUP-POINT SET SCREW
RETICLE COVER
CORRECTION WEDGE WORM
NO 10 x 1/2 SLOTTED STUD
MIRROR ASSEMBLY
90-DEGREE PRISM
CONSTANT RISE CAM ASSEMBLY
NO 8 x 3/8 FILLISTER-HEAD SCREW
NO 10 x 3/8 CUP-POINT SET SCREW
NO 10 x 6.656 LEAD SCREW
RA PD 180288

*Figure 302. Focusing collimator lens alining assembly.*

reticle and the telescope reticles. Tighten the four No. 10 cup-point set screws to secure the alining assembly to the housing.

*Note.*—When the beam-splitter prism assembly (fig. 302) is positioned against the left $\frac{3}{8}$ x $1\frac{7}{16}$ hex-head screw of the beam splitter stop assembly, the sighting reticle can be seen only through the left telescope. To focus the sighting reticle through the right telescope, position the beam-splitter prism assembly against the right hex-head screw.

*c. Focusing the Reticle Assemblies.*

(1) Remove each reticle cover by unscrewing four No. 8 x $\frac{5}{16}$ fillister-head screws (fig. 169) and loosen two No. 8 x $\frac{1}{4}$ cup-point set screws (fig. 304) and three No. 5 x $\frac{1}{4}$ fillister-head screws in each reticle assembly.

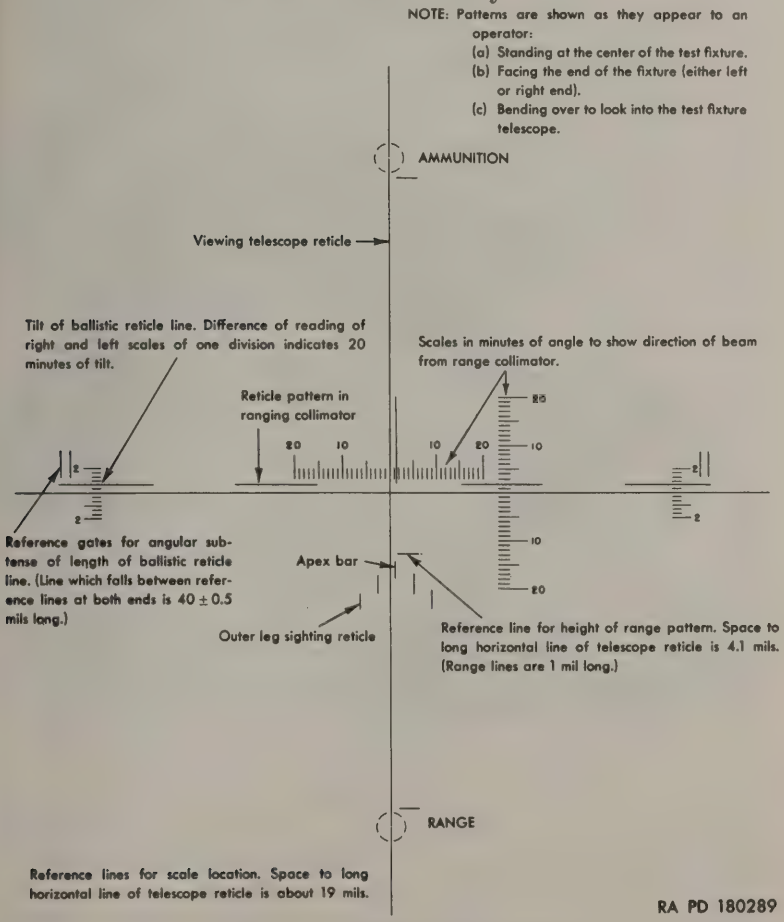
NOTE: Patterns are shown as they appear to an operator:
(a) Standing at the center of the test fixture.
(b) Facing the end of the fixture (either left or right end).
(c) Bending over to look into the test fixture telescope.
AMMUNITION
Viewing telescope reticle
Tilt of ballistic reticle line. Difference of reading of right and left scales of one division indicates 20 minutes of tilt.
Scales in minutes of angle to show direction of beam from range collimator.
Reticle pattern in ranging collimator
Reference gates for angular subtense of length of ballistic reticle line. (Line which falls between reference lines at both ends is 40 ± 0.5 mils long.)
Apex bar
Outer leg sighting reticle
Reference line for height of range pattern. Space to long horizontal line of telescope reticle is 4.1 mils. (Range lines are 1 mil long.)
RANGE
Reference lines for scale location. Space to long horizontal line of telescope reticle is about 19 mils.
RA PD 180289

*Figure 303. Sighting reticle pattern.*

(2) Viewing the left stereo reticle pattern through the right telescope and the right reticle pattern through the left telescope, insert a screwdriver in the eccentric and turn it to focus the reticles. There should be no apparent parallax between the stereo reticle pattern and crosslines of the viewing telescope reticles. Tighten the three fillister-head screws.

(3) To remove any tilt in the stereo pattern, insert a punch or a small diameter rod in the hole in the reticle cell assembly and rotate the assembly until the ends of the outer legs of the pattern are parallel to the horizontal crossline of the telescope reticles. Apply orange shellac varnish and tighten the two No. 8 x 1/4 cup-point set screws.

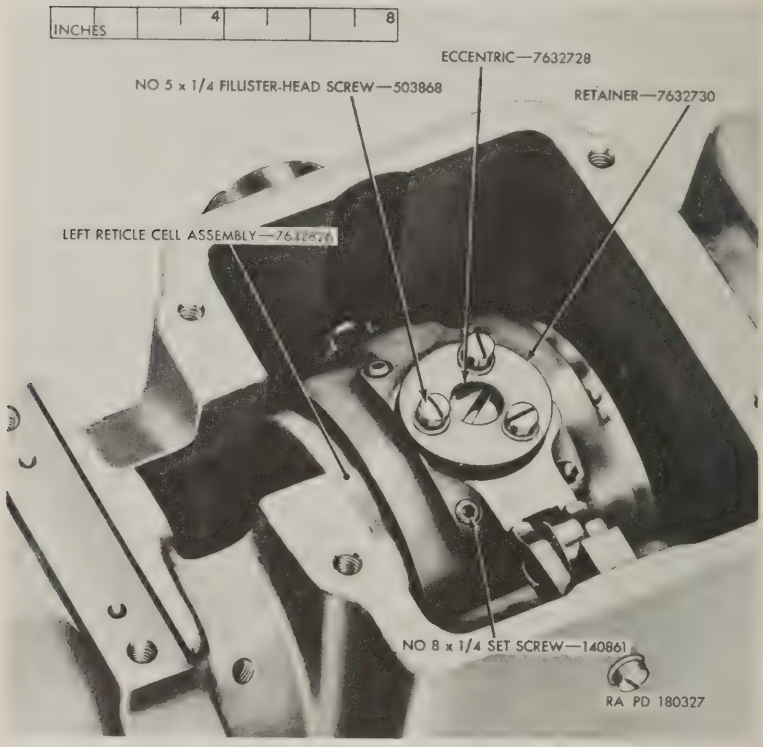


*Figure 304. Adjusting left reticle cell assembly.*

*d. Tilt Adjustment of Sighting Reticle.* Loosen three No. 8 x 1/2 fillister-head screws (fig. 197) which secure the retainer and the prism to the prism support, and one No. 8 x 3/8 cup-point set screw in prism support. Insert a punch or small-diameter rod into the hole in the prism, and rotate the prism until the sighting reticle

when viewed through the left telescope is parallel to its image when viewed through the right telescope. Tighten the three fillister-head screws, apply orange shellac varnish and tighten the set screw.

*Note.*—The tolerance of tilt is 20 minutes of arc, but if held from 5 to 10 minutes tilt between images, the remainder of tolerance can be utilized for later adjustments.

*e. Adjustment of ICS Correction Wedge Gear Assembly of the Right Correction Wedge Housing Assembly for the Wedge Base-Down Position.*

(1) Remove the right correction wedge housing assembly (fig. 168) from the collimator housing by unscrewing four No. 10 x ½ filister head screws and sliding off the four No. 10 lock washers.

(2) Position the beam-splitter prism assembly (fig. 302) against the left ⅜ x 1 1/16 hex-head screw of beam-splitter stop bracket. Adjust this screw until the apex bar of the stereo reticle is centered exactly over the vertical crossline of the right telescope reticle. Apply orange shellac varnish and lock the hex head screw in position by tightening the hex jam nut.

(3) Replace the correction wedge housing assembly on the collimator housing, securing it with the four No. 10 x ½ fillister-head screws and lock washers.

(4) Loosen two No. 10 x 3/16 cup-point set screws (fig. 190) in the correction wedge housing. Remove the No. 5 x 5/32 cone-point set screw. Unscrew the clamping ring using the improvised 2.4-inch pin-type spanner wrench. Pull the collimator correction wedge cell assembly from the correction wedge housing.

(5) Rotate the correction wedge gear assembly by turning the correction wedge worm (fig. 302) until the stereo reticle pattern in the right telescope reaches the highest point of its travel. At this point the apex bar of the reticle pattern is exactly over the vertical crossline of the telescope reticle. This procedure results in a true base down position of the correction wedge gear assembly. The correction wedge gear assembly (fig. 190) should not be moved from this position until, using a scriber or other sharp pointed tool, a line is scribed on the worm and correction wedge housing to indicate this position (par. 55*d*).

(6) Replace the collimator correction wedge cell assembly in the correction wedge housing, screw in the clamping ring and secure with the No. 5 x 5/32 set screw to which orange shellac varnish has been applied.

(7) Rotate the collimator correction wedge cell assembly until the stereo reticle pattern, when viewed through the right telescope, appears at its lowest position with the apex bar exactly over the vertical crossline of the telescope reticle. Tighten the two No. 10 x 3/16 cup-point set screws in the housing, with the correction wedge cell assembly in this position, the base of the wedge is up.

*f. Adjustment of the Left Correction Wedge Housing Assembly.*

(1) Rotate the correction wedge gear assembly by turning the correction wedge worm until the stereo reticle image, when viewed through the left telescope reaches the highest point of its travel. At this point the base of the wedge is in the down position.

(2) Loosen two No. 10 x 3/16 cup-point set screws (fig. 190) in the housing and rotate the collimator correction wedge cell assembly until the stereo reticle image reaches the lowest point of its travel. At this point the base of the wedge is in the up position.

(3) Center the apex bar of the stereo reticle pattern over the vertical line of the left telescope reticle by rotating the correction wedge gear assembly and the collimator correction wedge cell assembly equal amounts in opposite directions.

(4) Apply orange shellac varnish and tighten the two No. 10 x 3/16 cup-point set screws.

*g. Check of Tilt and Plumb Travel Between the Sighting Reticle and the Telescope Reticle Crossline.*

(1) View through telescopes and note if the sighting reticle is parallel to the horizontal crossline of the telescope reticle within 20 minutes of arc in each field.

(2) If within this tolerance, also check the plumb travel (amount of deviation from the horizontal crossline at different locations) of the sighting reticle by rotating the constant rise cam assembly (fig. 302). The plumb travel must not vary more than 0.1 millimeter or the thickness of one line width.

(3) If both the tilt and the plumb travel are within tolerances, no adjustment of the mirror assembly is necessary.

*h. Adjustment of Tilt and Plumb Travel Between the Sighting Reticle and the Telescope Reticle Crossline.*

(1) Unscrew two No. 8 x 3/8 fillister-head screws and (fig. 302) No. 8 lock washers, unhook the extension spring from the mirror assembly, and remove the mirror assembly from the collimator housing.

(2) Pull the two 1/8 x 3/8 straight pins (fig. 167) from the collimator housing and replace the mirror assembly, securing it loosely with the two No. 8 x 3/8 fillister-head screws and lock washers.

(3) Hold the mirror assembly firmly against the collimator housing and rotate the assembly in either direction until the sighting reticle is parallel to the horizontal line of the telescope reticle within 20 minutes of arc when viewed through either telescope. Tighten the two No. 8 x 3/8 fillister-head screws to hold the mirror assembly in this position.

(4) Check the plumb travel (amount of deviation from the horizontal telescope crossline at different locations) of the sighting reticle by rotating the constant rise cam assembly. The tolerance is 0.1 millimeter (one line width).

*Note.*—Plumb travel will usually be eliminated when the adjustment for tilt ((1) through (3) above) is made.

If the amount of travel exceeds the tolerance, the No. 8 x 3/8 fillister-head screws must be loosened, and the tilt adjusted and checked for the plumb travel within 0.1 millimeter. Again tighten the fillister-head screws firmly.

(5) Grease (par. 65*a* and *b*) and drive two 1/8 x 3/8 straight pins through the mirror bracket and into the collimator housing to maintain position of the mirror assembly on the housing. If a tight fit is not secured, it will be necessary to drill and ream for oversize straight pins. Hook the extension spring back onto the mirror assembly.

*i. Centering the Ballistic Reticles in Right and Left Telescopes.*

(1) Loosen three No. 8 x 3/8 fillister-head screws of each 90° prism (fig. 302). To center the range scale index and ammo scale index as viewed in the left telescope reticle, rotate the two 90° prisms until, when viewed through the left telescope, the range and ammo indexes are on the vertical crossline of the telescope reticle.

*Note.*—The beam-splitter prism assembly must be located against the left 3/8 x 17/16 hex head special screw of the beam-splitter stop bracket assembly.

(2) Center the sighting reticle pattern as viewed in the left telescope by rotating the No. 10 x 6.656 lead screw until the vertical line of sighting reticle is centered over the vertical crossline of the telescope reticle when viewed through the left telescope.

(3) Position the beam-splitter prism assembly against the right 3/8 x 17/16 hex-head screw of the beam-splitter bracket assembly and loosen the hex jam nut. Rotate the hex-head screw until the vertical line of sighting reticle is centered over the vertical crossline of the right telescope reticle when viewed through the right telescope.

*Note.*—The centering tolerance of the sighting reticle from right to left telescope is 0.1 millimeter or the width of the vertical line of the sighting reticle.

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*j. Check Optical Alinement.* Again check the complete optical alinement and adjust if necessary, for some of the later adjustments may have affected those made previously.

## Section IV. ASSEMBLY OF BALLISTIC CAM HOUSING ASSEMBLY (T41)

### 291. In-Process Inspection

Refer to paragraph 230 for general rebuild instructions. Apply grease (par. 65*a* and *b*) to the teeth of all gears and to all ball bearings before assembling. Clean all parts before assembly (par. 63).

### 292. Assembly of Cam Drive Bracket Assembly

*a.* Compress the two internal snap retaining rings (fig. 156) using snap ring pliers and release them into the recesses of the spur gear

*b.* Tap the two ball bearings into the spur gear.

*c.* Slide the stud through the gear, the plain washer, and the gear bracket. Secure the stud to the bracket by driving a No. 6/0 x ½-inch taper pin through the bracket and the stud (par. 59*b*).

*d.* Compress the two internal snap retaining rings (fig. 155) with snap ring pliers and release them into the recesses in the spur gear. Tap the two ball bearings into the gear.

*e.* Slide the stud through the gear, the plain washer, and the gear bracket. Secure the stud to the bracket by driving a No. 4/0 x ⅞-inch taper pin through the bracket and stud.

### 293. Assembly of Cam Housing Support and Related Parts

*a.* Assemble the follower holder and related parts as described in (1) through (3) below:

(1) Screw the cam follower (fig. 154) into the follower holder and secure it with a No. 000 x ⅞-inch taper pin through the holder and the follower (par. 59*b*).

(2) Screw the 5/16 x 1¼ flat-point set screw into the holder.

(3) Slide a No. 10 lock washer on the No. 10 x ⅝ socket-head cap screw and screw it into the holder.

*b.* Install the follower holder and related parts as described in (1) through (4) below:

(1) Insert the compression spring (fig. 153) into the recess in the cam housing support.

(2) Position the follower holder on the compression spring and the support, and slide the stud through the support and the holder. Drive a No. 000 x ⅞-inch taper pin through the holder and the stud to secure the holder to the support.

(3) Slide the cam follower through the support and secure it to the support with a plain washer and a ⅜-inch hex-nut.

(4) Drive a No. 000 x 7/8-inch taper pin through the nut and the follower.

*c.* Place the rear bellows retaining plate (fig. 152) and the ballistic cam housing bellows in position on the support.

*d.* Position the front bellows retaining plate on the bellows and the support and secure them to the support with ten No. 8 x 5/8 socket-head cap screws and No. 8 lock washers.

*e.* Drive a 3/8 x 1 1/8 straight pin into the support.

*f.* Position the cam housing bearing on the support and secure the center race to the support with four 5/16 x 7/8 socket-head cap screws and 5/16-inch lock washers.

*g.* Drive two 3/16 x 1 1/8 straight pins (fig. 147) into the outer race of the cam housing bearing.

### 294. Assembly of Ballistic Cam and Related Parts

*a.* Slide the spur gear (fig. 151) on the shaft and secure the gear to the shaft by driving a No. 00 x 1 1/8-inch taper pin through the gear and the shaft (par. 59*b*).

*b.* Grease and drive a 1/4 x 1 3/8 straight pin into the spur gear.

*c.* Slide the reverse cam and the ballistic cam on the shaft, position them on the straight pin, and secure them to the gear with three 1/4 x 1 cap screws and 1/4-inch lock washers.

*d.* Slide the ball bearings (fig. 150) and the spacer on the shaft.

*e.* Screw the 7/16-inch collar on the shaft and secure it to the shaft by driving a No. 000 x 7/8-inch taper pin through the collar and the shaft.

*f.* Assemble the ball bearings (fig. 149), the spacer, and the 7/16-inch collar to the other end of the shaft and secure the collar by driving a No. 000 x 7/8-inch taper pin through the collar and shaft.

### 295. Installation of Cam Drive Bracket Assembly

*a.* Position the cam drive bracket assembly (fig. 148) in the ballistic cam housing and secure it to the housing with three No. 10 x 7/8 fillister-head screws and three No. 10 lock washers.

*b.* Grease and drive a 5/32 x 1 straight pin into the housing.

*c.* Screw a 5/16 x 1 1/2 flat-point set screw and a 5/16 x 5/8 flat-point set screw into the housing.

### 296. Installation of Cam Housing Support and Related Parts

*a.* Position the cam housing bearing and support (figs. 152 and 153) in the cam housing (fig. 147), sliding the two straight pins of the outer race through the holes in the cam housing.

*b.* Screw four 5/16 x 7/8 socket-head cap screws through the housing to secure the outer race of the cam housing bearing to the housing.

*c.* Slide three 5/16-inch lock washers on three 5/16 x 1/2 fillister-head

screws and screw them through the housing into the other outer race to secure the race to the housing.

*d.* Secure the bellows and the rear bellows retaining plate to the cam housing with eight No. 8 x 5/8 socket-head cap screws and eight No. 8 lock washers.

*Note.*—Eight more screws will be added when the housing is secured to the main housing and the cover to the cam and the main housings.

### 297. Installation of Level Vial Tube

Drive a 1/16 x 1/4 straight pin through the cam housing support. Insert the level vial tube (fig. 146) in the cam housing support, sliding it through the level vial tube cover held in position in the support. Adjust level to bottom surface of support with four set screws. Screw the 0.576 x 0.23 plug in the support. Secure the plug with a 1/16 x 15/16 straight pin through the support.

### 298. Installation of Ballistic Cam Housing Cover, Ballistic Cam and Related Parts

*a.* Insert the improvised holding screw 7662083 (fig. 144) in the follower holder to place tension on the compression spring in order that the ballistic cam and assembled parts can be inserted without interference.

*b.* Position the ballistic cam housing cover (fig. 145) on the assembled ballistic cam with related parts and insert both into the housing, fitting the other end of the cam into the recess in the opposite side of the housing.

*c.* Secure the cover to the housing with four No. 10 x 1/2 fillister-head screws and No. 10 lock washers.

*d.* Place the 0.005 thickness gage (fig. 144) between the cam and the follower. Loosen holding screw 7662083 until there is tension on the thickness gage when it is moved forward or backward. Turn in the flat-point set screw until tension is just removed from the holding screw. Tighten the socket-head cap screw to hold the set screw in this position.

*e.* Remove the holding screw. The expansion of the spring positions the follower holder against the ballistic cam.

### 299. Installation of Ballistic Cam Housing Support Caps

Position the ballistic cam housing support caps (fig. 143) on the cam housing support, and secure them with eight 1/4 x 7/8 socket-head cap screws, and eight 1/4-inch lock washers.

## Section V. ASSEMBLY OF BALLISTIC CAM HOUSING ASSEMBLY (M12)

### 300. In-Process Inspection

Refer to paragraph 230 for general rebuild instructions. Apply grease (par. 65*a* and *b*) to the teeth of all gears and to all ball bearings before assembling.

### 301. Assembly of Segment Gear Assembly

*a.* Grease and drive a $\frac{3}{16}$ x $\frac{11}{16}$ straight pin (fig. 165) into the support. Position the segment gear on the support, locating it on the straight pin, and insert a $\frac{3}{8}$ x $1\frac{1}{4}$ hex-head cap screw through the support and the gear. Secure the gear to the support with a $\frac{3}{8}$-inch hex nut and $\frac{3}{8}$-inch spring lock washer on the cap screw.

*b.* Insert the cam follower through the support and the gear. Screw a $\frac{3}{8}$ x $\frac{5}{8}$ hex nut on the follower and drive a No. 6/0 x 1-inch taper pin through the nut and the follower (par. 59*b*).

### 302. Assembly of Cam Drive Bracket Assembly

Proceed the same as described for the T41, paragraph 292, (figs. 155 and 156).

### 303. Assembly of Follower Holder and Related Parts

Proceed the same as for the T41, paragraph 293*a* (fig. 154).

### 304. Assembly of Ballistic Cam and Related Parts

Proceed the same as for the T41, paragraph 294 (figs. 149, 150, and 151).

### 305. Assembly of Superelevation Assembly

*a.* Tap the two ball bearings (fig. 164) into the bracket. Compress the two internal snap rings using snap ring pliers, and release them in the recesses in the bracket.

*b.* Slide the 27-tooth spur gear on the shaft and secure it to the shaft by driving a No. 6/0 x $\frac{1}{2}$-inch taper pin through the gear and the shaft (par. 59*b*).

*c.* Slide the shaft through the bracket, slide the 160-tooth spur gear on the shaft, and secure it to the shaft by driving a No. 6/0 x $\frac{1}{2}$-inch taper pin through the gear and the shaft.

*d.* Position the synchro torque transmitter (fig. 163) on the bracket and secure it to the bracket with three synchro transmitter mounting clamps held to the bracket by three screws and three No. 5 lockwashers.

*e.* Slide the spacer, the washer, and the spur gear on the synchro transmitter, bending two prongs of the washer into the drilled holes in the gear to position the washer and the gear. Secure the assembled parts to the transmitter with a No. 10 x $\frac{1}{8}$ slotted round nut.

*f*. Screw a No. 8 x 3/8 fillister-head screw with a No. 8 lockwasher into the bracket to secure the closed clip that holds the harness assembly to the bracket.

*g*. Solder the wires of the harness assembly to the clips of the synchro transmitter (par. 64).

### 306. Installation of Cam Drive Bracket Assembly

Proceed the same as for the T41, paragraph 295 (fig. 148).

### 307. Installation of Cam Housing Bearing, Segment Gear Assembly, Ballistic Cam Housing Bellows, and Related Parts

Install the came housing bearing, segment gear assembly, ballistic cam housing bellows as described in paragraph 293*c* through *g* and 296 for the telescope T41.

*Note.*—Parts are similar, except M12 has a segment gear (figs. 161 and 162).

### 308. Installation of Follower Holder and Related Parts

Install the follower holder as described in paragraph 293*b* for the telescope T41 (fig. 160).

*Note.*—Parts are similar, except M12 has a segment gear assembly instead of a cam housing support.

### 309. Installation of Level Vial Tube

Install the level vial tube as described in paragraph 297 for the telescope T41 (fig. 159).

### 310. Installation of Ballistic Cam Housing Cover, Ballistic Cam, and Related Parts

Install the ballistic cam housing cover, ballistic cam as described in paragraph 298 for the telescope T41 (fig. 158).

### 311. Installation of Superelevation Assembly

Position superelevation assembly (fig. 157) to the sides of the cam housing, grease and drive a 3/16 x 5/8 straight pin and a 3/16 x 1 straight pin through the housing and into the superelevation assembly. Secure the superelecation assembly to the right side of the housing with two 1/4 x 7/8 fillister-head screws, and to the left side with three 1/4 x 5/8 fillister-head screws.

### 312. Installation of Ballistic Cam Housing Support Caps

Install the ballistic cam housing support caps as described in paragraph 299 for the telescope T41 (fig. 157).

## 313. In-Process Inspection

Apply grease (par. 65*a* and *b*) to the teeth of all gears and to all ball bearings before assembling. Refer to paragraphs 61*e* and *f* for the coating and cementing of optics. Be sure when assembling the optical elements that they are properly positioned by observing the identification markings made during disassembly. Refer to paragraph 230 for general rebuild instructions.

## 314. Assembly of Prism Differential Spider Assembly

*a.* Position the two spur pinions (fig. 136) on the tube retainer and drive the two straight pins through the tube retainer and the pinions to secure the pinions to the retainer.

*b.* Slide the tube into the tube retainer and secure it in position by staking at three equally spaced points.

## 315. Assembly and Adjustment of Prism Support Assembly

*a. Assembly.*

(1) Drive the two $\frac{1}{8}$ x $\frac{1}{2}$ straight pins and two $\frac{1}{8}$ x $\frac{7}{16}$ straight pins (fig. 137) into the drilled holes in the prism support and position the two prisms in the prism support locating with the straight pins entering drilled holes of the prisms. Aline the threaded holes of the prism and the support.

(2) Secure the two prisms to the support with two No. 8 x $\frac{1}{2}$ socket-head cap screws and two No. 8 x $\frac{3}{8}$ socket-head cap screws.

(3) Slide the two ball bearings on the prism support, making sure that they fit snugly to the support shoulders.

*b. Adjustment for Deviation in Parallel Light.*

(1) Remove the retainer ring (fig. 305) and place the prism support assembly in the mount with the coarse knurl away from the collimator.

(2) Replace the retainer ring and tighten the ring until the bearings are loaded and the assembly is free to turn.

(3) Mount the telescope on the fixture and connect the collimator to an electrical outlet.

(4) Position the image crosshairs on the telescope grid pattern as described in (*a*) through (*g*) below.

(*a*) Position image by turning the assembly until the arrow is *up* and the ball is to the right.

(*b*) Adjust the two lower holder adjusting screws until the vertical image crosshair is coincident with the vertical center line of the grid pattern.

(*c*) Rotate the image 360° by turning the assembly 180°. If the vertical crosshair is not coincident with the vertical

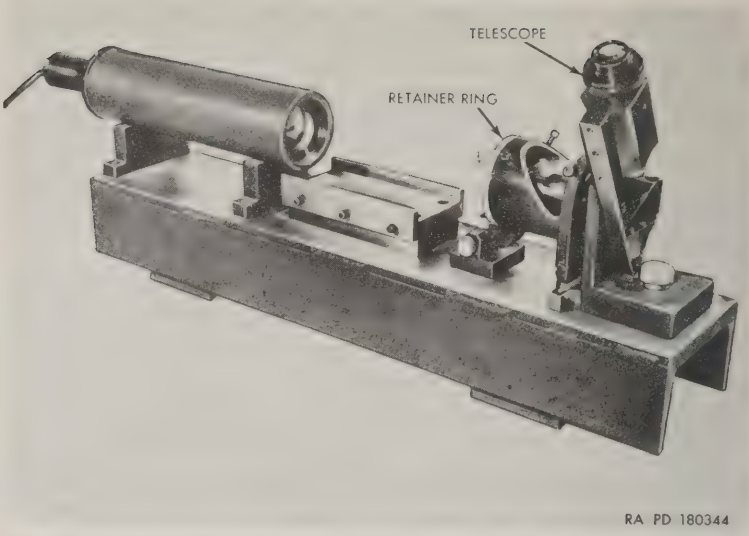


*Figure 305. Adjusting for deviation in parallel light on objective lens cell assembly and erector cell adjusting fixture 7660917.*

grid center line, move the vertical crosshair one-half the distance from the vertical grid center line by turning the adjusting screws.

(*d*) Rotate the image 360° by turning the assembly 180° (arrow up) and check to see that the vertical crosshair is on the opposite side of and the same distance from the vertical center grid line as it was in (*c*) above.

(*e*) Center the horizontal image crosshair arrow down.

(*f*) Adjust the top holder adjusting screws until the horizontal crosshair is coincident with the horizontal center line of the grid pattern.

(*g*) Rotate the image as in (*c*) and (*d*) above and adjust the adjusting screws until the horizontal crosshair is on the opposite side of and the same distance from the horizontal center grid line as it was following the first rotation.

(5) Rotate the assembly 360° and observe the image crosshairs relative to the grid pattern. Adjust both prisms for a minimum of deviation. Each small division of the telescope grid pattern is equal to 4.50 minutes. Allowable tolerance is 18 minutes.

*c. Adjustment for Image Wander in Converging Light.*

(1) Mount the assembly as described in *b* (1) and (2) above.

(2) Attach the microscope (fig. 306). Mount the objective lens.

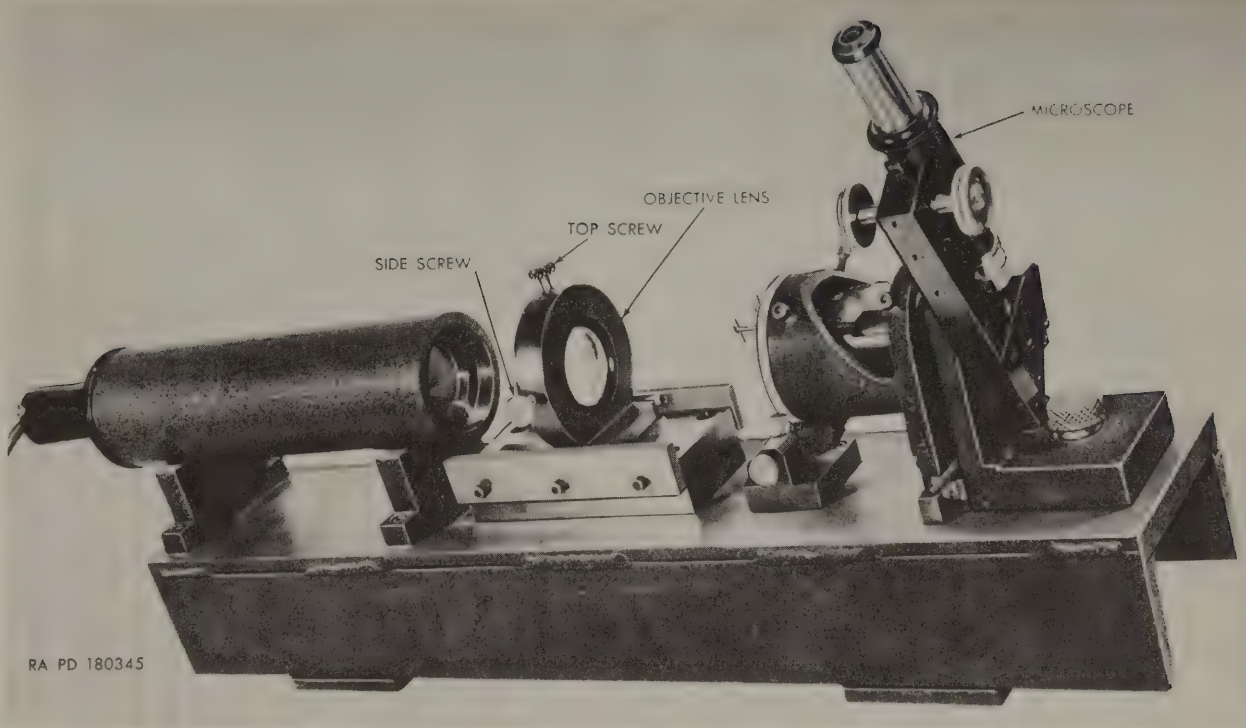


*Figure 306. Adjusting prism support assembly for image wander in converging light.*

(3) Bring the grid pattern into focus by adjusting the height of microscope and move the image into pattern by turning the microscope.

(4) Focus the image on the gird pattern by moving the objective lens in the ways.

(5) Obtain good alinement of the objective lens and the assembly by reducing image crosshair wander as indicated in (*a*) through (*e*) below.

(*a*) Position the image by turning the assembly until the arrow is up and the ball is to the right.

(*b*) Observe the location of the vertical crosshair with respect to the grid pattern. (Turn the microscope and refocus the objective lens, if necessary, to position cross-hair on the grid pattern.)

(*c*) Rotate the image 180° by turning the assembly 90° (arrow down) and note the location of the vertical crosshair relative to its location when the arrow was up.

(*d*) Move the vertical crosshair one-half of the difference between these two locations by adjusting the side screw (fig. 306) on the objective lens. Continue to make adjustments until the difference between the two locations of the vertical crosshair is at a minimum.

(*e*) Reduce horizontal crosshair movement to a minimum as described above. Make objective lens adjustments with the top screw.

(6) While observing the movement of the center of the image crosshairs relative to the grid pattern, rotate the assembly 360°. The diameter of the largest circle must not exceed 0.007 inch. The grid division of the microscope is equal to 0.004 inch.

(7) If necessary, adjust the prisms and check deviation in parallel light and if adjustment is necessary, check image wander.

## 316. Assembly of Prism Differential Assembly

*a.* Drive one $\frac{1}{8}$ x $\frac{1}{2}$ straight pin (fig. 135) into the drilled hole in the prism support assembly.

*b.* Position the prism differential spider assembly to the prism support assembly locating with the straight pin in the support entering the drilled hole in the spider assembly and aline the threaded holes of the support assembly with the drilled holes of the spider assembly.

*c.* Secure the spider assembly to the support assembly with four No. 8 x $\frac{7}{8}$ fillister-head screws and four No. 8 lock washers.

## 317. Assembly of 90° Prism Holder Assembly

Drive two $\frac{5}{32}$ x $\frac{7}{16}$ straight pins (fig. 140) into the two drilled holes in the 90° prism holder. Position the two 90° prisms on the holder

locating with the straight pins entering the drilled hole of the prism. Aline the drilled holes of the prism with the threaded holes in the holder and secure the two prisms to the holder with six No. 8 x 7/16 fillister-head screws.

### 318. Assembly of Second Collective Lens Cell Assembly

*a.* Clean (par. 63) and carefully insert the second collective lens (fig. 142) into the second collective lens cell. Be sure that the lens is correctly positioned following the identification markings made in the disassembly.

*b.* Screw the retaining ring into the cell using tubular wrench 41–W–3726–143.

*c.* Using hand injection gun J022–7648117 and the adapter (fig. 11), inject adhesive sealing compound 52–C–3257–220 (par. 67) into the injection sealing ports in the cell to seal the lens in the cell.

### 319. Assembly of First Collective Lens Cell Assembly

*a.* Clean (par. 63) and insert the first collective lens (fig. 141) into the first collective lens cell. Be sure that the lens is correctly positioned following the identification markings made in disassembly and is not wedged or cocked in the cell.

*b.* Screw in the retaining ring with tubular wrench 41–W–3726–113 to secure the lens in the cell.

*c.* Using the hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject static noncuring compound 52–C–3258–500 (par. 68) into the injection sealing ports in the cell to seal the lens in the cell.

### 320. Assembly of Prism and Collective Lens Assembly

*a.* Secure the two second collective lens cell assemblies (fig. 139) to the 90° prism holder assembly with eight No. 8 x 1/4 round-head screws.

*b.* Screw the two first collective lens cell assemblies (fig. 138) to the holder assembly with tubular wrench 41–W–3726–150. Secure each with one No. 5 x 1/4 flat-point set screw.

*c.* Adjust the 90° prisms on the holder adjusting fixture 7660961 (fig. 307) as described in (1) and (2) below.

(1) Position the partially assembled prism and collective lens assembly on the holder adjusting fixture 7660961 (fig. 307) with the prism support assemblies to the right and to the left of the holder in their normal positions. Adjust the prisms for horizontal alinement by loosening the six No. 8 x 7/16 fillister-head screws (fig. 140) that hold the 90° prisms to the holder. Adjust the prisms until the arrows show vertical on the reticle. If the vertical alinement varies, select another prism with corrective deviation.

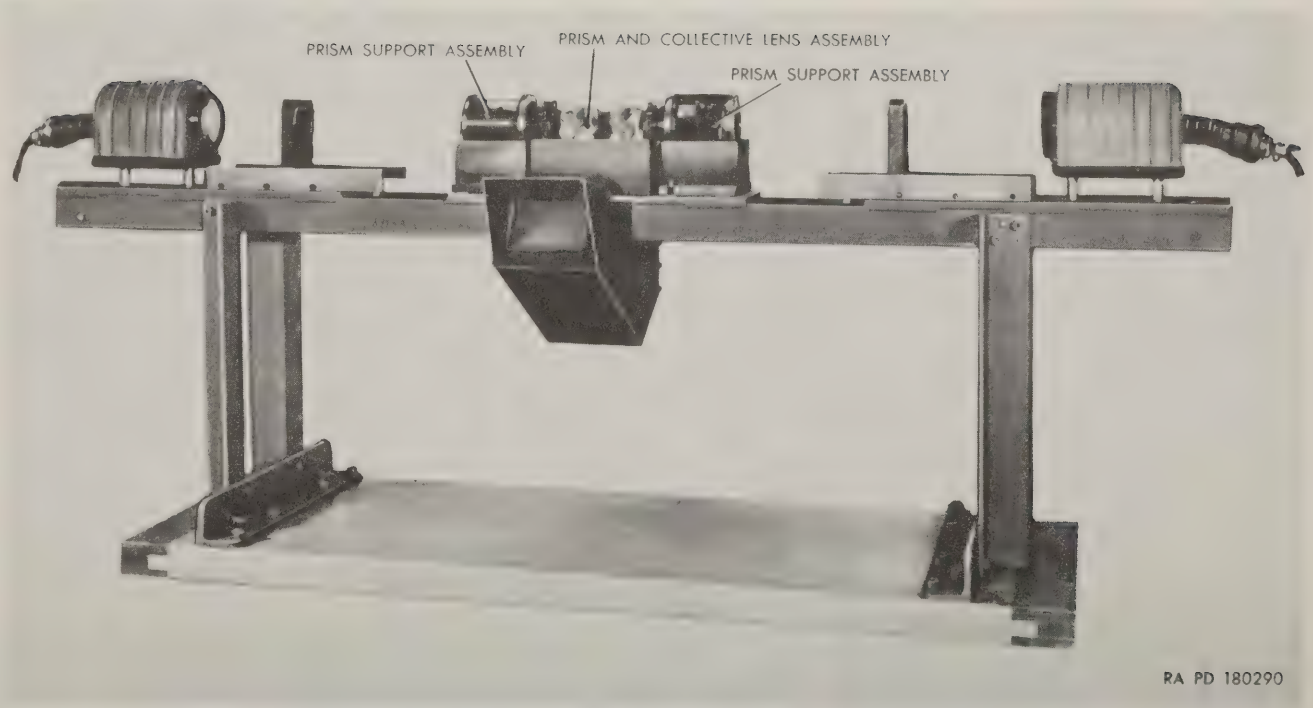


*Figure 307. Adjusting the 90° prisms on holder adjusting fixture 7660961.*

(2) Disassemble to clean (par. 63), assemble and aline prism. Apply orange shellac varnish to all screws except one No. 5 x ¼ flat-point set screw (fig. 138).

## 321. Assembly of Telescope Bearing Housing Assembly

*a.* Compress the two internal snap rings (fig. 134) with snap ring pliers, insert the rings in the telescope bearing housing, and release them in the proper recesses.

*b.* Press the two ball bearings into the housing making sure that they fit properly and are not in a cocked position. Slide the spur gear through the ball bearings in the housing, screw the collar on the gear adjusting to eliminate end play. Secure the collar by driving a No. 6 x ½-inch taper pin through the collar and the gear (par. 59*b*).

*c.* Assemble the spur gear (fig. 133) to the housing as described in *b* above.

*d.* Clean (par. 63) and lubricate (par. 65*b*) the two ball bearings (fig. 132) and press them to the housing taking care that they are seated properly and not cocked.

*e.* Screw the retaining ring into the housing using tubular wrench 41–W–3726–330. Secure it with a No. 5 x ¼ cone-point set screw through the housing. Do not apply orange shellac varnish to the set screw at this time.

## 322. Assembly of Telescope Mounting Bearing and Related Parts

*a.* Lubricate (par. 65*b*) and press the two ball bearings (fig. 131) into the telescope mounting bearing making sure that they fit snugly and are not cocked.

*b.* Screw the retaining ring into the mount using an improvised 2.5-inch pin-type spanner wrench (fig. 52) and install a No. 5 x ¼ cone-point set screw to secure the ring. Do not apply orange shellac varnish to the set screw.

## 323. Assembly of Objective Lens Cell Assembly

*a.* Insert the objective lens (fig. 130) in the objective lens cell. Screw in the retaining ring using tubular wrench 41–W–3726–170 to secure the lens in the cell.

*b.* Using a hand injection gun J022–7648117 and the adapter (fig. 11), inject adhesive sealing compound 52–C–3257–220 (par. 67) into a sealing port in the cell to seal the lens to the cell.

*c.* Inspect the cell assembly on the lens bench as explained in paragraph 324.

## 324. Inspecting Cell Assemblies on Lens Bench

*a. Scope.* Cell assemblies (mounted lenses) are inspected on the vertical lens bench 7658995 (fig. 16) for runout and imperfections

that may be caused by improper mounting of the objective in the cell.

*b. Preparation for Inspection.*

(1) Place the cell assembly in the correct adapter (see table IV) and place the adapter in the adapter carrier (fig. 308).

(2) Move the carrier on the column to the approximate focal length of the cell assembly as previously determined in seting up the lens bench.

(3) Turn on the light source.

*c. Runout.*

(1) Runout is the difference between the mechanical and optical center of the lens.

(2) Observe the focus dot in comparison to the mechanical center of the lens and see if it is within the maximum tolerance allowed (see table IV).

*d. Image Quality.*

(1) Observe for the roundness of focal dot.

(2) Observe to see that there is a single image.

*e. Rejection.* Reject all parts that are not within the given tolerances.

*Table IV. Adapters and Tolerances for Lenses and Cell Assemblies*

| Adapter | Fig. No. | Used with part No. | Part found on fig. No. | Back focal length | Maximum runout |
|---|---|---|---|---|---|
| 7659159 | 8 | Cell assy 7632918 | 119 | 12.771 inches ± 0.128 inches. | 0.3 mm. |
| 7659162 | 8 | Cell assy 7632932 | 116 | 13.790 inches ± 0.150 inches. | 0.6 mm. |
| 7659165 | 8 | Cell assy 7632933 | 116 | 10.488 inches ± 0.105 inches. | 0.25 mm. |

## 325. Assembly of Erector Lens Assembly 7632933

*a.* Examine the erector lens (fig. 129) for any defects such as chips or cracks and refer to the identification markings on the lens made in disassembly. Carefully insert the lens in the erector lens cell.

*b.* Using tubular wrench 41–W–3726–183, screw the retaining ring into the erector lens cell. Secure the retaining ring with a No. 2 x 1/8 cone-point set screw through the cell to the retaining ring.

*c.* Using hand injection gun J022–7648117 and the adapter (fig. 11), inject adhesive sealing compound 52–C–3257–220 (par. 67) into the injection sealing ports to seal the erector lens to the cell.

*d.* Inspect the cell assembly on the lens bench as explained in paragraph 324.

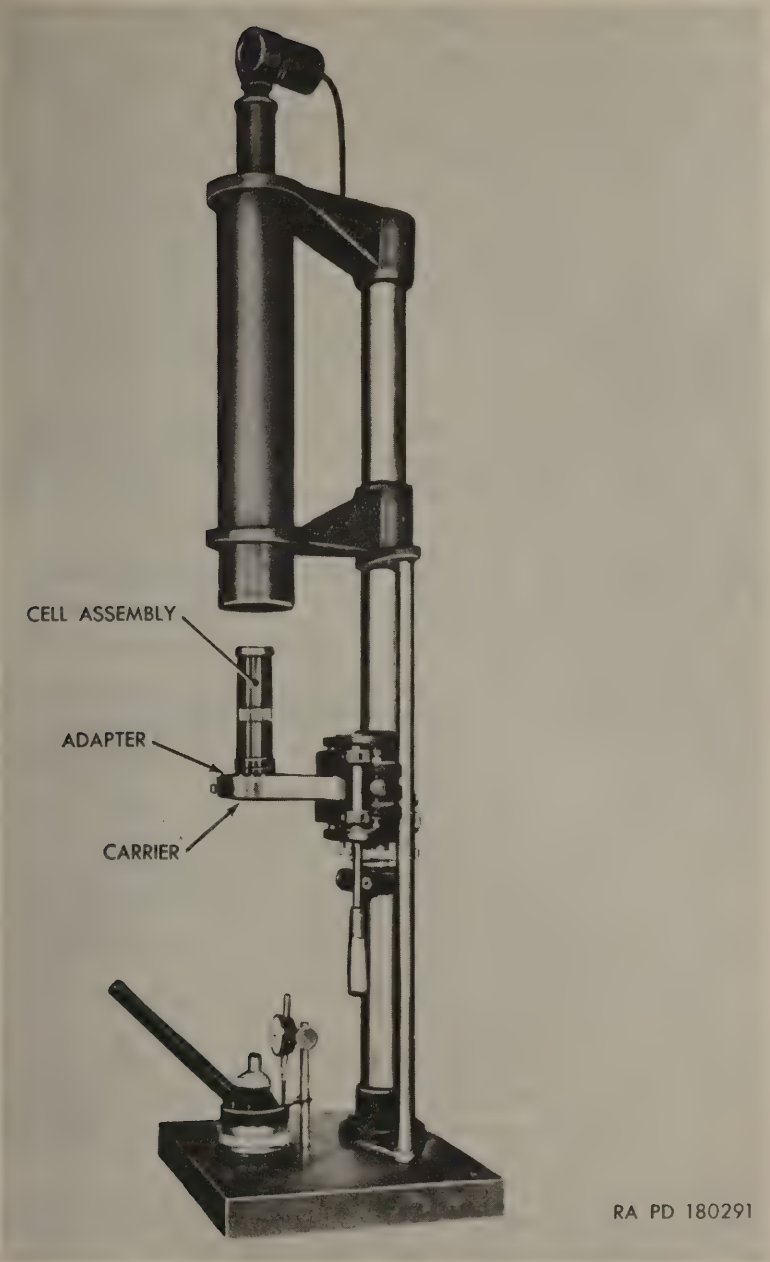


*Figure 308. Inspecting cell assembly in vertical lens bench 7658995.*

## 326. Assembly of Erector Cell Assembly 7632932

*a.* Examine the erector lens (fig. 128) for any defects such as chips or cracks and refer to identification marking on lens made in disassembly. Carefully insert the lens in the erector lens cell.

*b.* Using tubular wrench 41–W–3726–183, screw the retaining ring into the cell.

*c.* Secure the ring in position by screwing a No. 2 x 3/32 cone-point set screw through the cell to the retaining ring.

*d.* Using hand injection gun J022–7648117 and the adapter (fig. 11), inject adhesive sealing compound 52–C–3257–220 (par. 67) into the sealing ports to seal the erector lens in the cell.

*e.* Inspect the cell assembly on the lens bench as explained in paragraph 324.

## 327. Assembly of 90° Prism Bracket Assembly 7632931

Drive a 5/32 x 7/16 straight pin (fig. 115) into the 90° prism bracket. Position the 90° prism on the bracket and secure the prism to the bracket with three No. 8 x 1/2 socket-head cap screws.

## 328. Assembly of 90° Prism Bracket Assembly 7632928

Follow the same procedure as explained in paragraph 327 (fig. 114).

## 329. Assembly of Eyepiece Assembly

*a.* To assemble the eyepiece adapter, drive two 1/16 x 3/8 straight pins (figs. 126 and 127) into the eyepiece adapter. Clean (par. 63) and position the prism in the eyepiece adapter. Secure the prism to the adapter with the two No. 8 x 3/8 fillister-head screws.

*b.* Drive the two shoulder pins (fig. 113) into the eyepiece support and rivet over the pins to secure them to the support.

*c.* To assemble the knob shaft and the shaft bearing (fig. 112), slide the bearing and the collar on the shaft and secure the collar to the shaft by driving a No. 5/0 x 9/16-inch taper pin through the collar and the shaft (par. 59*b*).

*d.* Assemble the eyepiece cell assembly as indicated in (1) through (3) below.

(1) Examine the eyelens and field lens (fig. 125) and replace if pitted or scratched. Refer to the identification markings made in disassembly and insert the eyelens, the separator, and the field lens, into the eyepiece cell.

(2) Examine the lens diaphragm threads for a stripped condition and chase if necessary. Screw the diaphragm into the cell using tubular wrench 41–W–3726–98.

(3) Using hand injection gun J022–7648117 and the adapter (fig. 11), inject adhesive sealing compound 52–C–3257–220

(par. 67) into the injection sealing ports to seal the lenses in the cell.

*e.* Assemble the stripped eyepiece adapter assembly as described in (1) through (3) below.

(1) Slide the cell assembly (fig. 109) into the eyepiece adapter and screw a No. 5 x 0.225 fillister-head screw through the eyepiece adapter to engage the slot in the eyepiece cell of the cell assembly.

(2) Slide the diopter scale adapter and the locking ring on the cell assembly and secure the locking ring with a No. 2 x 3/32 cone-point set screw through the ring to the cell assembly.

(3) Inspect the diopter scale for wear and legibility (par. 71) and slide it on the diopter scale adapter. Slide the eyepiece index on the cell assembly and secure each with a No. 2 x 1/8 flat-point set screw.

*f.* Install the eyepiece adapters, support and related parts as described in (1) through (4) below.

(1) Position the left eyepiece adapter (fig. 113) and the right eyepiece adapter to the shoulder pins previously installed on the eyepiece support. Secure both adapters with a shoulder pin through the drilled holes and rivet over the pin.

(2) Position the interpupillary connecting nut in the yoke of the left adapter. If the nut fits too snugly in the yoke, it is necessary to scrape or lap the yoke of the adapter to obtain a good fit. Lubricate the nut with grease (par. 65*b*).

(3) Position both adapters in their respective bores in the eyepiece housing. Open to their extreme outer position and check the spread of the adapters. The minimum spread is 4.330 inches, measured on the outer bores in the adapters with a vernier caliper (fig. 112).

(4) Drive the two 3/32 x 3/8 straight pins (fig. 113) into the eyepiece housing. Position the eyepiece support to the eyepiece housing, locating on the straight pin. Secure it to the housing with three No. 8 x 3/8 fillister-head screws and seal the screws with a drop of orange shellac varnish.

*g.* Install the interpupillary adjustment knob shaft assembly as described in (1) through (4) below.

(1) Drive the two 3/32 x 5/16 straight pins (fig. 112) into the eyepiece housing.

(2) Lubricate the threads with grease (par. 65*a* and *b*), slide the interpupillary adjustment knob shaft assembly into the eyepiece housing, locating it on the straight pins. Use a screwdriver in the slot of the shaft to screw the shaft into

the interpupillary connecting nut which was assembled to the left eyepiece adapter.

*Note.*—If the original nut and shaft are used, it is necessary to engage the proper threads as indicated by scribe marks on the collar and the bearing made in disassembly. If new parts are used, the threads of the nut and shaft must be lapped before assembly for smooth and easy operation.

(3) Secure the shaft assembly to the housing with three No. 2 x 5/16 fillister-head screws and three No. 2 lock washers.

(4) Using hand injection gun J022–7648117 and the adapter (fig. 11), inject noncuring sealing compound 52–C–3258–505 (par. 69) into the sealing ports in the eyepiece housing around the knob assembly.

*h.* Install the eyepiece cover and related parts as described in (1) through (3) below.

(1) Clean (par. 63) the eyepiece cover (fig. 110) carefully to eliminate dirt or excess paint. Position it to the eyepiece housing and secure it to the housing with seven No. 8 x 1/2 oval-head screws.

(2) Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–3258–500 (par. 68) into the injection sealing ports in the cover.

(3) Position the interpupillary gasket and the eyepiece seal on the cover and secure them to the cover by screwing the 15/8 x 1/8 slotted nut on the eyepiece adapter using an improvised 2 1/8-inch hook spanner wrench (fig. 48) and compressing the seal approximately 0.005 inch. Stake the nut to the adapter in three equal spaces and apply orange shellac varnish to the exposed adapter threads to form a lock seal between the nut and the adapter.

*i.* To install the stripped eyepiece adapter assembly, drive two 1/16 x 1/4 straight pins (fig. 109) into the drilled holes of the eyepiece seal. Position the assembled eyepiece adapter on the eyepiece seal, locating on the straight pins. Secure the adapter to the seal with three No. 5 x 3/16 fillister-head screws and three plain washers.

*j.* Install the interpupillary adjustment knob and related parts as indicated in (1) through (4) below.

(1) Position the interpupillary adjustment scale index (fig. 111) on the eyepiece housing with the index mark pointed away from the housing and with the drilled hole of the index alined with the threaded hole in the housing. Apply orange shellac varnish to a No. 2 x 3/32 cone-point set screw and insert the set screw to secure the index to the housing.

(2) Position the interpupillary distance scale on the interpupillary adjustment knob. Apply orange shellac varnish to the

No. 2 x $\frac{3}{32}$ cone-point set screw and secure the scale to the knob with the screw.

(3) Insert a screwdriver in the slot of the shaft, turn the shaft clockwise to the closed position of the adapters, and slide the knob on the shaft with the marking of 58 opposite the index mark. At this position the drilled hole in the knob and the shaft line up and the knob is secured to the shaft by driving a varnished No. 5/0 x $\frac{3}{4}$-inch taper pin through the knob and the shaft (par. 59*b*). Also check the open position of the adapters for the index setting of 72.

(4) At this point the interpupillary distance or the axis-to-axis distance of the adapters is measured by sliding the jaws of a vernier caliper over the two adapters. By deducting the diameter (1.6300) of one adapter from the overall measurement, a distance of 58 mm $\pm 0.05$ must be obtained.

## 330. Alining Eyepiece Assembly

*a.* To optically aline the eyepiece assembly, position the eyepiece assembly on the eyepiece optical axis alinement fixture 7658936 (fig. 309). This fixture duplicates the surfaces on which the eyepiece assembly is normally mounted and provides a pair of reticle images (crosslines) at the same positions, relative to the mountings, as are the images formed by the range finder erectors. Actuating the interpupillary knob changes the interpupillary distance and when viewing through the eyepieces an image movement should not be introduced to exceed four minutes in opposite directions.

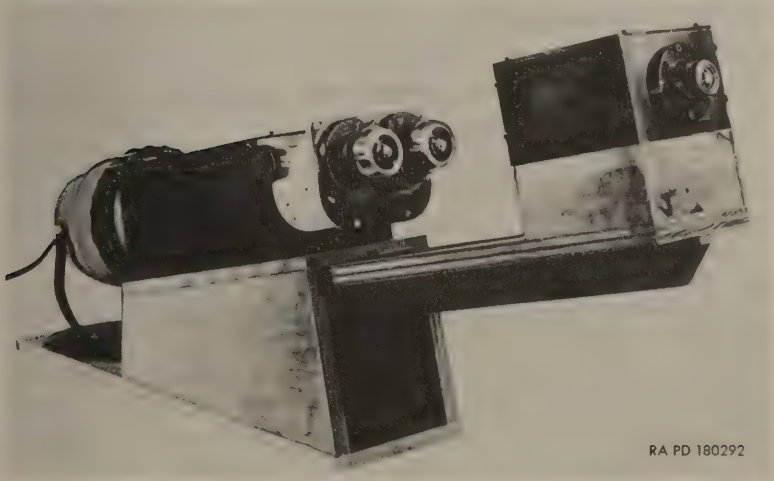


*Figure 309. Optical alinement of eyepiece assembly on eyepiece optical axis alinement fixture 7658936.*

*b.* Using hand injection gun J022–7648117 and the adapter (fig. 11), inject sealing adhesive compound 52–3257–220 into the injection sealing ports of the eyepiece adapter until it is forced out of adjacent holes. Insert eight No. 5 x 1/16 flat-point screws (fig. 109) into the sealing ports. Bake in an oven for three hours at 160° F. or air harden for twelve hours (par. 67).

## 331. Installation of First and Second Collective Lens Cell Assemblies and 90° Prism Holder Assembly

*a.* Remove the No. 5 x 1/4 flat-point set screw (fig. 138) and unscrew the first collective lens cell assembly from the prism holder assembly using tubular wrench 41–W–3776–150.

*Note.*—No orange shellac varnish had been applied to the No. 5 x 1/4 set screw in the assembly.

*b.* Now insert the partially assembled prism and collective lens assembly into the tube easing the first collective lens cell assembly into the end opening of the tube.

*c.* Using the same tubular wrench, screw the other first collective lens cell into the prism holder through the opening in the other end of the tube. Apply orange shellac varnish and screw the No. 5 x 1/4 set screw into the holder to secure the cell assembly to the holder.

## 332. Installation of Prism and Collective Lens Assembly

Slide the prism with lens assembly (fig. 124) into the tube. Position the three threaded holes of the holder to aline them with the three drilled holes in the tube and secure the assembly to the tube by one No. 10 x 7/8 fillister-head screw in the center and two No. 10 x 5/8 fillister-head screws at each end. Apply orange shellac varnish to the screws.

## 333. Installation of Prism Differential Assembly and Prism Support Assembly

*a.* Clean (par. 63) and slide the prism support assembly (fig. 123) into the right end of the tube. Use an improvised 2.7-inch pin-type spanner wrench (fig. 53) to screw in the retaining ring enough to allow the support assembly to turn on the bearings smoothly but without end play.

*b.* Secure the ring in position with a No. 5 x 3/16 cone-point set screw (fig. 122). Apply orange shellac varnish to the screw.

*c.* Clean and slide the prism differential assembly into the left end of the tube. Screw in the retaining ring with an improvised 2.7-inch pin-type spanner wrench sufficiently to allow the differential assembly to turn on the bearings smoothly but without end play.

*d.* Secure the ring in position with a No. 5 x 3/16 set screw. Apply orange shellac varnish to the screw.

*e.* Rotate the support assembly and the differential assembly to their approximate positions and secure with four No. 10 x 7/16 cup-point set screws. Do not seal the set screws at this time.

### 334. Installation of Gear and Tube

*a.* Screw the gear (fig. 122) into the left end of the large tube, and screw the small tube into the right end of the large tube. Tighten the gear and small tube with an improvised 0.477-inch bar wrench (fig. 45) through the holes of the gear and small tube while holding the large tube with strap wrench 41–W–3382 (fig. 14).

*b.* Secure the gear and the tube to the tube with the two No. 5 x 3/16 cone-point set screw to which orange shellac varnish has been applied.

### 335. Installation of Segment Gear

Position the segment gear (fig. 119) on the tube and secure the segment gear to the tube with two No. 10 x 1/2 fillister-head screws and two No. 10 lock washers. Do not seal the screws.

*Note.*—The 1/8 x 5/16 straight pin is not assembled until after the final collimation of the range finder.

### 336. Installation of Telescope Bearing Housing Assembly and Adapter

*a.* Slide telescope bearing housing assembly (fig. 121) on the tube.

*b.* Loosen the No. 5 x 1/4 cone-point set screw (fig. 132) from the housing and adjust the retaining ring, using tubular wrench 41–W–3726–330, until the bearing is free and does not bind. If bind is noted, free the bearing and work it in until the bind is eliminated. Tighten the No. 5 x 1/4 set screw and apply orange shellac varnish.

*c.* Insert the improvised 0.477-inch bar wrench in the tube to hold the tube in position and screw the adapter (fig. 121) into the tube, using a strap wrench 41–W–3382, until the scribed index lines line up.

*d.* Insert a No. 5 x 3/32 cone-point set screw to secure the adapter to the tube. Apply orange shellac varnish to the set screw.

### 337. Installation of Telescope Mounting Bearing and Related Parts

*a.* Slide the bearing assembly (fig. 120) on the gear and screw the retaining ring on the gear using an improvised 2.7-inch pin-type spanner wrench to secure the bearing to the gear.

*b.* Loosen the No. 5 x 1/4 cone-point set screw in the bearing (fig. 131) and tighten the retaining ring in the bearing using the same spanner wrench until the action of the bearing is free and smooth and without end play. Work in, if necessary, to obtain a satisfactory fit. Tighten the No. 5 x 1/4 set screw and apply orange shellac varnish.

*c.* Adjust the retaining ring for snug fit of the bearing to the gear (fig. 120) and install a No. 5 x 5/32 cone-point set screw and apply orange shellac varnish.

*d.* Screw the adapter to the gear and line up the scribed index lines on the adapter and gear using the improvised 0.477-inch bar wrench through the large holes in the gear to hold it in position as the adapter is turned with strap wrench 41–W–3382.

*e.* Insert a No. 5 x 3/32 cone-point set screw to secure the adapter to the gear. Seal the set screw with orange shellac varnish.

### 338. Installation of Objective Lens Cell Assembly and Related Parts

Screw the objective lens cell assembly (fig. 119) into the cell adapter using tubular wrench 41–W–3726–200. Secure the assembly to the cell adapter loosely with a No. 10 x 1/8 flat-point set screw. Slide the cell adapter into the adapter and secure it loosely with the retaining ring using tubular wrench 41–W–3726–240. Insert the two No. 10 x 1/8 flat-point set screws loosely into the adapter.

*Note.*—The set screws and the retaining rings will be tightened in the optical alinement.

### 339. Installation of Erector Cell Assemblies

*a.* Vacuum brush the lower housing (fig. 116) and apply a thin film of grease (par. 65*b*) to the threads of the cell assemblies.

*b.* Clean the optics (par. 63) and using telescope wrench 7659126 (fig. 39), screw the two long erector cell assemblies into the housing, turning two or three threads or until about one-half the length of the flutes show through the adjustment holes in the housing.

*c.* Clean the optics of the two short erector cell assemblies and grease threads (par. 65*b*). Use the focusing wrench 7659139 (fig. 38) to screw the assemblies into the housing approximately four or five threads or until one-half the length of the flutes show through the adjustment holes.

### 340. Installation of 90° Prism Bracket Assembly 7632931

Place the telescope prism adjusting eccentric (fig. 115) in the drilled hole in the mounting surface of the lower housing and position the cleaned 90° prism bracket assembly to the lower housing. Firmly secure two No. 8 x 1/2 fillister-head screws to the housing.

### 341. Installation of 90° Prism Bracket Assembly 7632928

Follow the same procedure as described in paragraph 340 (fig. 114).

## 342. Installation of Upper and Lower Housings and Related Parts

*a.* Drive a ¼ x ⅝ straight pin (fig. 108) into the mounting surface of the upper housing. Position the lower housing to the upper housing and secure it to the upper housing with seven No. 10 x ¾ socket-head cap screws and seven No. 10 lock washers.

*b.* Place inner bellows rim on telescope bellows loosely, position the bellows and the outer bellows rim to the mounting surface of the upper housing and secure the rim and the bellows to the housing with fourteen No. 10 x ⅜ oval-head screws.

*c.* Insert the telescope housing alining pin into the drilled hole in the telescope tube, position the upper housing mounting surface on the mounting surface of the telescope tube, and secure the housing to the tube with four 5/16 x ⅞ hex-head cap screws and 5/16 lock washers.

## 343. Installation of Eyepiece Assembly, Telescope Covers, Collective Lens Cover and Plug

*a.* Position the mounting surface of the eyepiece assembly (fig. 107) on the lower housing, lining up the threaded and drilled holes. Secure the eyepiece assembly to the lower housing with six No. 10 x ⅝ socket-head cap screws and six No. 10 lock washers.

*b.* Position the side telescope cover and the front telescope cover on the housings and secure to the housings with twelve No. 8 x ½ fillister-head screws and twelve No. 8 lock washers.

*c.* Apply orange shellac varnish and screw the ⅜-inch pipe plug into the threaded adjustment hole in the tube. Position the collective lens cover on the tube and secure it with two No. 8 x ¼ fillister-head screws.

## 344. Optical Alinement Process for Telescope Assembly

*a. Focusing and Centering the Optical Axis of the Tube.*

(1) Disconnect the tube (fig. 108) from the upper housing by unscrewing the four 5/16 x ⅞ hex-head screws and lock washers which secure the upper housing to the tube.

(2) Place the tube on the target collimator 7661426 (fig. 310), securing it to the mounting surface of the telescope mounting bearing and the telescope bearing housing assembly with four hex-head bolts.

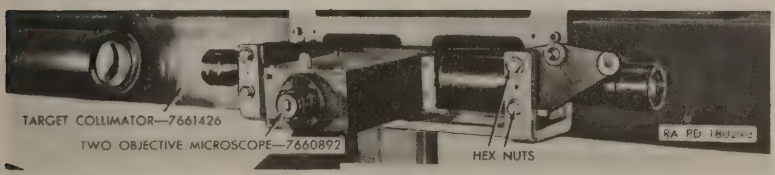


*Figure 310. Optical alinement of telescope assembly on target collimator 7661426.*

(3) Position the two objective microscope 7660892 on the mounting surface of the tube and secure it to the tube with two of the hex-head cap screws.

(4) Focus the objective lens cell assembly as indicated in (*a*) through (*c*) below.

(*a*) Block off the light from either end of the target collimator by inserting a card between the telescope tube and the target collimator.

(*b*) When viewing through the microscope, insert tubular wrench 41–W–3726–170 into the slots of the retaining ring of the objective cell assembly. To focus, turn the cell assembly until the two objective microscope reticle pattern (fig. 311) is in the same plane with the crosslines of the target collimator. Remove the blocking card, insert it at the other end and repeat the procedure.

(*c*) Unscrew the retaining ring (fig. 119) using tubular wrench 41–W–3726–240. Slide out the cell adapter with the cell

LEFT COLLIMATOR RETICLE
RIGHT COLLIMATOR RETICLE
VIEW WITH TWO OBJECTIVE MICROSCOPE MOUNTED ON FACE OF MAIN TELESCOPE TUBE.
ONE DIVISION CORRESPONDS TO 2 MINUTES IN APPARENT FIELD OF THE FINISHED RANGE FINDER.
3 DEG
3 DEG
TEST FOR CHANGE OF RELATIVE POSITION OF IMAGES WITH ELEVATION ROTATION OF THE TELESCOPE TUBE. (SEE NOTE 1.)
20 10 0 10 20
VERTICAL DISPLACEMENT OF IMAGE FROM NOMINAL POSITION IN THOUSANDTHS OF AN INCH AT THE FIRST FOCAL PLANE IN THE TELESCOPE.
TWO OBJECTIVE MICROSCOPE RETICLE
20 10 0 10 20
3 DEG
3 DEG
30 30
PARALLELISM OF IMAGES IN RIGHT AND LEFT SIDES OF TELESCOPE. DIFFERENCE OF READING OF 1 DIVISION OF UPPER AND LOWER SCALES CORRESPONDS TO 20 MINUTES OF RELATIVE TILT.
20 10 0 10 20
ERECTNESS OF IMAGE IN RIGHT AND LEFT SIDE OF TELESCOPE AND DISPLACEMENT FROM NOMINAL POSITION. DIFFERENCE IN READING OF TOP AND BOTTOM SCALES OF 1 DIVISION CORRESPONDS TO TILT OF 2 DEGREES. AVERAGE READING IS HORIZONTAL DISPLACEMENT OF IMAGE IN THOUSANDTHS OF AN INCH AT THE FIRST FOCAL PLANE IN THE TELESCOPE.
3 DEG
3 DEG
FOCUS REFERENCE: USE TWO OBJECTIVE MICROSCOPE RETICLE AS REFERENCE TO FOCUS MAIN TELESCOPE OBJECTIVES. ELIMINATE PARALLAX BETWEEN IMAGES OF COLLIMATOR RETICLES AS FINAL OPERATION.
NOTE 1: EXACT COINCIDENCE OF PATTERNS IS NOT NECESSARY AT THIS STAGE SINCE ADJUSTMENTS CAN BE MADE IN THE SECOND AND THIRD PAIRS OF RIGHT-ANGLE PRISMS. APPLY TOLERANCE AS DETERMINED BY EXPERIENCE.
RA PD 180294

*Figure 311. Reticle pattern for two objective microscope and target collimator.*

assembly and tighten the two No. 2 x 1/16 set screws. Slide the cell adapter and the cell back in the adapter and screw in the retainer tightly with the same tubular wrench.

(5) Center the objective lens cell assembly as described in (*a*) and (*b*) below.

(*a*) Push the control button to rotate the target collimator and when viewing through the microscope, observe that the intersection of the collimator reticle crosslines does not wander more than 6 minutes of arc and is centered on a common axis. Adjustment is made for centering by tightening the four No. 10 x 1/8 flat-point set screws (fig. 119) until the correct position of the cell adapter is found that centers the objective lens.

(*b*) Unscrew the No. 10 x 1/8 flat-point set screws, one at a time, from the cell. Apply orange shellac varnish and again screw each into position.

*b. Sealing the Adapter.* Using hand injection gun J022–7648117 and the adapter (fig. 11), inject adhesive sealing compound 52–C–3257–220 (par. 67) into a sealing port of the cell until the compound flows out of the other ports. Clean off the excess sealing compound (par. 63).

*c. Timing the Prism Support and Prism Differential Assembly.*

(1) Remove the two No. 10 x 1/2 fillister-head screws and lock washers (fig. 119). Pull the segment gear from the telescope mounting bearing. Loosen the four No. 10 x 7/16 cup-point set screws in the tube (fig. 123).

(2) Insert a metal pick or pointed rod through the adjustment holes in the tube to engage the knurled section of the support assemblies. Rotate the assemblies until, when viewing through the objective microscope, the vertical crosslines of the collimator reticles are parallel to each other within 20 minutes of tilt.

*Note.*—The difference of reading of one division of upper or lower scale corresponds to 20 minutes of relative tilt. In this position the images from the left and the right side of the tube are parallel.

(3) Tighten the four No. 10 x 7/16 set screws in the tube.

(4) Position the segment gear (fig. 119) on the telescope mounting bearing, meshing its teeth with those of the spur pinions of the prism differential spider assembly and secure the segment gear to the bearing with two No. 10 x 1/2 fillister-head screws and two No. 10 lock washers.

(5) Check for parallelism and repeat the timing adjustment if necessary.

*d. Focusing and Centering the Erector Cell Assemblies.*

(1) Secure the tube on the upper housing (fig. 108) as explained in paragraph 342. Remove the eyepiece assembly (fig. 107), the telescope side cover, and the telescope front cover by removing the attaching screws and lock washers.

(2) Remove the two 90° prism assemblies (figs. 114 and 115) and the two telescope prism adjusting eccentrics from the lower housing. Loosen the four ¼ x ⅜ cone-point set screws and remove the two short erector assemblies (fig. 116).

(3) Insert the telescope wrench 7659126 (fig. 39) into the slots of the long erector assembly and viewing through the optics of the wrench, observe the target collimator crossline (fig. 312). Turn the wrench to focus the wrench reticle image (circle) with the crossline. Remove the parallax in the same operation.

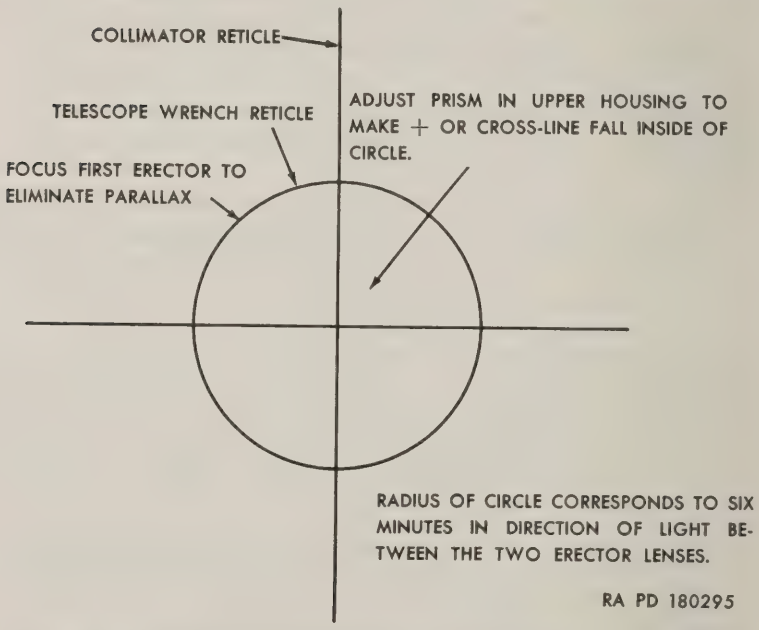
COLLIMATOR RETICLE
TELESCOPE WRENCH RETICLE
ADJUST PRISM IN UPPER HOUSING TO MAKE + OR CROSS-LINE FALL INSIDE OF CIRCLE.
FOCUS FIRST ERECTOR TO ELIMINATE PARALLAX
RADIUS OF CIRCLE CORRESPONDS TO SIX MINUTES IN DIRECTION OF LIGHT BETWEEN THE TWO ERECTOR LENSES.
RA PD 180295

*Figure 312. Reticle patterns for target collimator and telescope wrench 7659126.*

(4) Loosen the three No. 8 x ½ socket-head cap screws (fig. 114) that secure each 90° prism to the bracket and the three No. 8 x ½ fillister-head screws to free the eccentric in the upper housing. Make a horizontal adjustment by inserting a punch or small rod in the adjusting hole in the bracket to bring the intersection of crosslines to fall within the circle of the focus-

ing wrench reticle. Make a vertical adjustment to bring the crosslines intersection within the circle by turning the eccentric with a screwdriver until correctly positioned. Tighten the socket-heat screws which hold the prism to the bracket and the fillister-head screws to fix the eccentric. Insert the two ¼ x ⅜ cone-point set screws in the adjustment holes for the long erector cell assembly (fig. 116).

(5) Screw the short erector assembly into the lower housing using the focusing wrench 7659139 (fig. 38) and while turning, view through the optics of the wrench (fig. 313) until the crosslines of the target collimator reticles are sharp.

*Note.*—The heavy circle provides an observable target for an out of focus image on the focus screen.

(6) Replace the two 90° prism assemblies (fig. 115) and the telescope prism adjusting eccentrics in the lower housing and po-

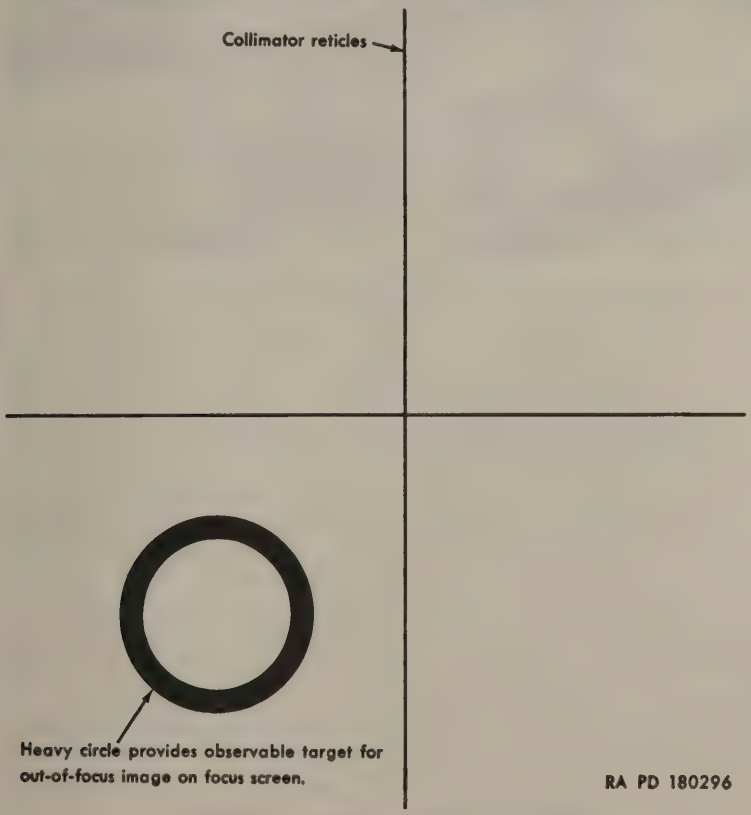
Main telescope, less lower prism pair and eyepiece, assembly is mounted on target collimator. Focusing wrench 7659139 observes images formed by second erector lenses.
Collimator reticles
Heavy circle provides observable target for out-of-focus image on focus screen.
RA PD 180296

*Figure 313. Images of second erector lenses.*

sition the erector image viewer 7660900 (fig. 314) on the lower housing, using the same screws used for the eyepiece assembly.

*e. Checking the Equality of the Magnification of the Right and Left Side of the Telescope Viewing Through the Erector Image Viewer.*

(1) Observe the left and right collimator crossline reticles (fig. 315). Loosen the three No. 8 x ½ socket-head cap screws (fig. 115) that secure the 90° prism to the bracket and the three No. 8 x ½ fillister-head screws to release the eccentric. Rotate the prism, inserting a punch or small rod in the hole in the prism bracket while turning the eccentric with a screwdriver until the single images of the right collimator marks fall between the double images of the left collimator marks.

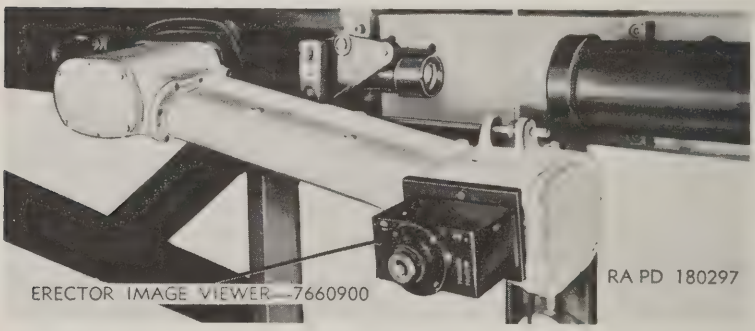


*Figure 314. Checking equality of magnification with erector image viewer 7660900.*

(2) If the magnification is less on one side, remove the two ¼ x ⅜ cone-point set screws (fig. 116) from the adjustment holes of that side, insert a small sharp pointed rod through the adjustment hole for the short erector cell assembly to engage the flutes. Turn the rod toward the long erector assembly or objective lens until the magnification is equal or the single image marks of the right collimator are within the double image marks of the left collimator. When in this position, move the long erector assembly an equal amount toward the objective lens by engaging the small pointed rod in the flutes and rotating the assembly. Again view through the image erector viewer to check magnification.

(3) Screw two ¼ x ⅜ cone-point set screws into the adjustment holes. Apply adhesive sealing compound (par. 67) over these two screws and also over the other two cone-point set screws.

1 DEG
1 DEG
LEFT COLLIMATOR RETICLE
RIGHT COLLIMATOR RETICLE
EQUALITY OF MAGNIFICATION IN LEFT AND RIGHT SIDES OF TELESCOPE SYSTEM. IMAGES OF RIGHT COLLIMATOR MARKS SHOULD FALL BETWEEN IMAGES OF LEFT COLLIMATOR MARKS. SPACE CORRESPONDS TO TOLERANCE OF ± 1 PERCENT ON MAGNIFICATION EQUALITY.
ERECTOR IMAGE VIEWER RETICLE
0.03
0.03
0.03
0.03
30
30
RELATIVE POSITION OF IMAGES FOR LEFT AND RIGHT TELESCOPE SYSTEMS. EACH DIVISION CORRESPONDS TO 2 MINUTES OF DIPVERGENCE OR DIVERGENCE IN THE FINISHED TELESCOPE.
VERTICAL DISPLACEMENT OF IMAGES FROM NOMINAL POSITION IN INCHES AT EYEPIECE FOCAL PLANE.
0.03
0.03
ERECTNESS OF IMAGES AND DISPLACEMENT FROM NORMAL POSITION. DIFFERENCE IN READING OF TOP AND BOTTOM SCALES OF ONE DIVISION CORRESPONDS TO TILT OF 20 DEGREES. AVERAGE OF READINGS GIVES HORIZONTAL DISPLACEMENT OF IMAGE IN INCHES AT EYEPIECE FOCAL PLANE.
PARALLELISM OF IMAGES. DIFFERENCE IN READING OF UPPER AND LOWER SCALES OF ONE DIVISION CORRESPONDS TO RELATIVE TILT OF 20 MINUTES.
1 DEG
1 DEG
RA PD 180298

*Figure 315. Reticle pattern when using erector image viewer 7660900*

*f. Adjustment for Divergence and Dipvergence of the Images in the Left and Right Telescopes.*

(1) Loosen the three No. 8 x ½ socket-head screws (fig. 115) of the prism bracket assembly and insert a punch or small rod in the hole in the prism bracket.

(2) Adjust for divergence by rotating the prism until the vertical right and left collimator reticle crosslines are superimposed on the "0" position of the reticle pattern of the erector viewer when the other side is blocked off (fig. 315). Apply orange shellac varnish and tighten the No. 8 x ½ socket head screws.

*Note.*—This position is used as a reference only. When setting the second prism it has to be within a specified tolerance which is given later. For practical purposes, set as close to the center line of the pattern as possible.

(3) Adjust for dipvergence by loosening the three No. 8 x ½ fillister-head screws (fig. 115) of the 90° prism assembly and turn the telescope prism adjusting eccentric until, when viewing through the erector image viewer, the horizontal crosslines of the collimator are superimposed on the "0" position of the reticle pattern of the erector image viewer (fig. 315). Apply orange shellac varnish and tighten the No. 8 x ½ fillister-head screws. Repeat the procedure for divergence and dipvergence of the other side with the first side blocked off. When both sides are viewed through the erector image viewer, the crosslines will be superimposed and on "0" positions of the reticle pattern within ±15 minutes dipvergence and 0 to 30 minutes divergence tolerances.

*g. Adjustment of the Eyepiece Diopter Scale Using a Dioptometer.*

(1) Remove the erector image viewer and replace the eyepiece assembly (fig. 107) with the No. 10 x ⅝ socket-head cap screws and No. 10 lockwashers. Set the dioptometer scale to the zero setting and hold the dioptometer (fig. 9) in position in front of one range finder eyepiece.

(2) View the target collimator crossline reticle through the dioptometer and adjust the eyepiece for focus by rotating the diopter scale.

(3) Set the rangefinder eyepiece for zero diopter by loosening the three No. 2 x ⅛ flat-point set screws of the diopter scale (fig. 109) and moving the scale until the "0" position is at the index. Tighten the set screws. Repeat the procedure for the other eyepiece.

## Section VII. INSTALLATION OF MAJOR ASSEMBLIES IN RANGE FINDER

### 345. Installation of Range Finder Mounting Posts

Screw two range finder mounting posts 7649062 (fig. 106) and one post 7649061 into the main housing.

### 346. Installation of Nameplate

Position the nameplate (fig. 103) on the main housing and secure it to the housing with two No. 5 x 1/8 round-head screws.

### 347. Installation of Collimator Cover

*a.* Position the collimator cover (fig. 106) on the main housing and secure it to the housing with four No. 8 x 7/16 flat-head screws.

*b.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52C–3258–500 (par. 68) into the injection sealing ports and insert four No. 10 x 1/8 round-point set screws into the sealing ports.

### 348. Installation of Cycle Valve and Valve Cap

Follow the procedure explained in paragraph 262*e* (fig. 104).

### 349. Installation of Sealing Plug

*a.* Apply orange shellac varnish to three No. 10 x 1/2 flat-head screws (fig. 103), insert the sealing plug into the hole in the main housing from the inside, and secure it to the housing with the three No. 10 x 1/2 flat-head screws.

*b.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing ports of the sealing plug. Insert two No. 5 x 1/8 flat-point set screws into the sealing ports.

### 350. Installation of Receptacle Housing Plate and Gasket

Position the gasket (fig. 100) and the receptacle housing plate on the main housing and secure it to the housing with four No. 10 x 1/2 fillister-head screws and four No. 10 lock washers.

### 351. Installation of Resistor Board Assembly

Position the resistor board assembly (fig. 102) in the main housing and secure the terminal board support to the housing with a No. 8 x 1/2 fillister-head screw and a No. 8 lock washer.

### 352. Installation of Wire Harness

*a.* Solder the wires of the wire harness (fig. 101) to the 12-female contact receptacle, referring to the wiring diagram (figs. 316 and 317). Position and secure the harness to the main housing with five closed clips held to the housing by five No. 8 x 3/8 fillister-head screws and five No. 8 lock washers.

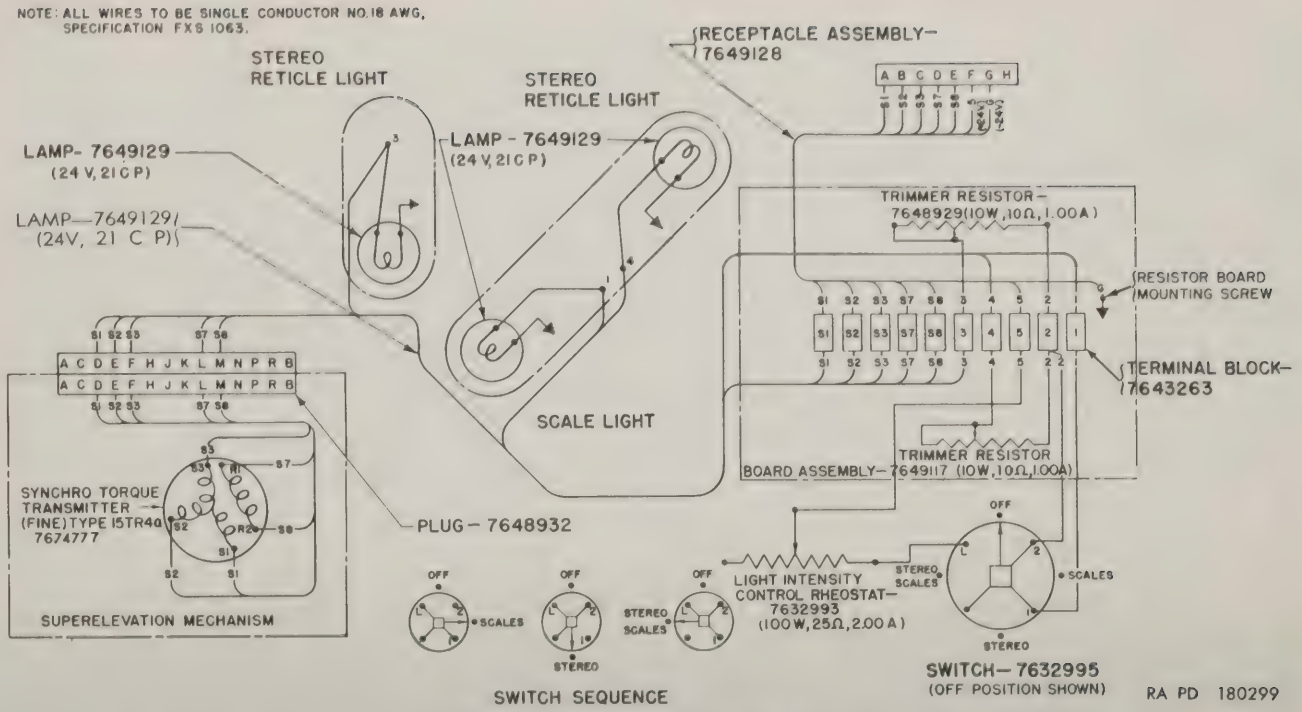
NOTE: ALL WIRES TO BE SINGLE CONDUCTOR NO.18 AWG, SPECIFICATION FXS 1063.
STEREO RETICLE LIGHT
STEREO RETICLE LIGHT
RECEPTACLE ASSEMBLY— 7649128
LAMP- 7649129 (24 V, 21 C P)
LAMP— 7649129 (24V, 21 C P)
LAMP - 7649129 (24 V, 21 C P)
TRIMMER RESISTOR— 7648929 (10W, 10Ω, 1.00A)
RESISTOR BOARD MOUNTING SCREW
TERMINAL BLOCK— 7643263
SCALE LIGHT
TRIMMER RESISTOR BOARD ASSEMBLY— 7649117 (10W, 10Ω, 1.00A)
SYNCHRO TORQUE TRANSMITTER (FINE) TYPE 15TR40 7674777
PLUG— 7648932
SUPERELEVATION MECHANISM
LIGHT INTENSITY CONTROL RHEOSTAT— 7632993 (100W, 25Ω, 2.00A)
SCALES
STEREO
OFF
SWITCH SEQUENCE
SWITCH— 7632995 (OFF POSITION SHOWN)
RA PD 180299

*Figure 316. Wiring diagram for range finder T41.*

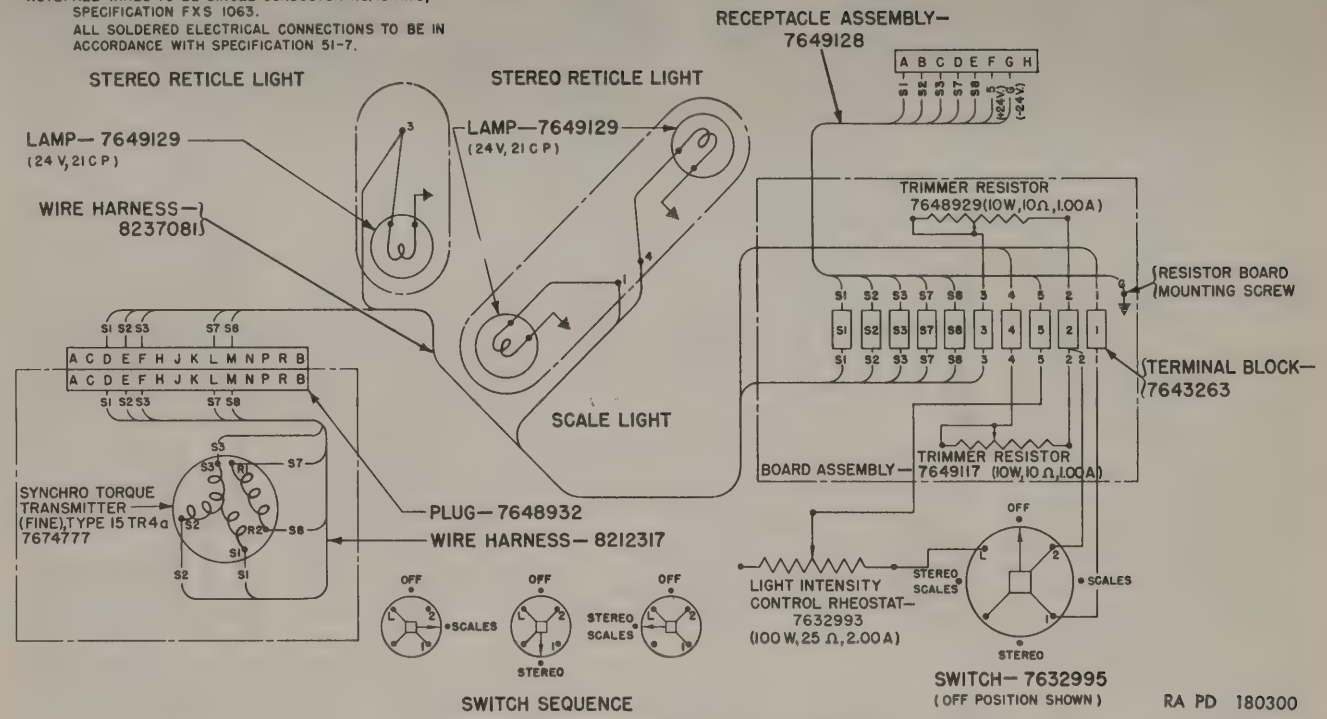
NOTE: ALL WIRES TO BE SINGLE CONDUCTOR NO. 18 AWG, SPECIFICATION FXS 1063.
ALL SOLDERED ELECTRICAL CONNECTIONS TO BE IN ACCORDANCE WITH SPECIFICATION 51-7.
STEREO RETICLE LIGHT
LAMP— 7649129
(24 V, 21 C P)
WIRE HARNESS— 8237081
STEREO RETICLE LIGHT
LAMP—7649129
(24 V, 21 C P)
SCALE LIGHT
RECEPTACLE ASSEMBLY— 7649128
A B C D E F G H
TRIMMER RESISTOR 7648929(10W, 10Ω, 1.00A)
RESISTOR BOARD MOUNTING SCREW
TERMINAL BLOCK— 7643263
BOARD ASSEMBLY—
TRIMMER RESISTOR 7649117 (10W, 10 Ω, 1.00A)
SYNCHRO TORQUE TRANSMITTER (FINE), TYPE 15 TR4a 7674777
PLUG— 7648932
WIRE HARNESS— 8212317
LIGHT INTENSITY CONTROL RHEOSTAT— 7632993
(100 W, 25 Ω, 2.00 A)
OFF
SCALES
STEREO
STEREO SCALES
SWITCH SEQUENCE
SWITCH— 7632995
(OFF POSITION SHOWN)
RA PD 180300

*Figure 317. Wiring diagram for range finder M12.*

*b.* Secure the terminal wires to the terminal block of the resistor board assembly with eight terminal screws.

### 353. Installation of Receptacle

*a.* Position the gasket (fig. 100) on the main housing. Pull the seven wires through the housing opening and secure the terminals to the terminal block of the resistor board assembly with seven terminal screws referring to the wiring diagram.

*b.* Position the eight pole receptacle on the main housing and secure it to the housing with four No. 8 x ½ fillister-head screws and four No. 8 lock washers.

### 354. Installation of Intermediate Drive Assembly and Flexible Shaft

*a.* Slide the flexible shaft (fig. 97) on the intermediate drive assembly and secure it with a No. 6/0 x ⅜-inch taper pin through the coupling and the intermediate drive shaft (par. 59*b*).

*b.* Drive two ⅛ x 9/16 straight pins into the main housing, position the intermediate drive assembly on the housing, locating on the straight pins. Secure it to the housing with two No. 10 x ⅜ fillister-head screws and two No. 10 lock washers.

### 355. Installation of Azimuth Bore Sight Drive Assembly

*a.* Drive two ⅛ x ⅝ straight pins (fig. 98) into the main housing and position the azimuth bore sight drive assembly on the housing, locating on the straight pins, with the gear teeth properly meshed with the gear teeth of the intermediate drive assembly.

*b.* Secure the azimuth bore sight drive bracket to the housing with two No. 10 x 9/16 fillister-head screws and two No. 10 lock washers.

### 356. Installation of Range Drive Assembly

Drive two ⅛ x ⅝ straight pins (fig. 99) into the housing, position the range drive assembly on the main housing locating on the straight pins, and secure it to the housing with four No. 10 x ⅝ fillister-head screws and four No. 10 lock washers.

### 357. Installation of Elevation Bore Sight Drive Assembly

*a.* Drive two ⅛ x ½ straight pins (fig. 97) into the main housing. Position the elevation bore sight drive assembly on the main housing, locating on the straight pins. Secure it to the housing with two No. 10 x ½ fillister-head screws and two No. 10 lock washers.

*b.* Connect the other end of the flexible shaft attached to the intermediate drive assembly to the elevation bore sight drive shaft and secure it with a No. 6/0 x ⅜-inch taper pin through the shafts (par. 59*b*).

## 358. Installation of Ballistic Correction Differential Assembly

*a.* Drive two 3/16 x 5/8 straight pins (fig. 96) into the main housing. Position the ballistic correction differential assembly on the housing, locating on the straight pins. Secure it to the housing with four No. 10 x 7/8 fillister-head screws and four No. 10 lock washers.

*b.* Apply orange shellac varnish under the heads of the screws to seal for water tightness.

*c.* Drive out the taper pin from the spur gear so that the gear will be free on the shaft for subsequent subassemblies.

## 359. Installation of Superelevation Mechanism Assembly

*a.* Drive two 1/8 x 1/2 straight pins (fig. 93) into the main housing. Position the superelevation mechanism assembly on the main housing, locating on the straight pins. Secure it to the housing with two No. 10 x 9/16 fillister-head screws, one No. 10 x 3/4 fillister-head screw, and three No. 10 lock washers.

*b.* Position the 12 female contact receptacle on the 12 male contact plug, position the receptacle clamps on the receptacle and the plug, and secure the clamps with two No. 6 hex nuts and two No. 6 lock washers.

*Note.*—The procedure in the assembly of the M12 is the same except that the female receptacle is positioned and secured to the male plug of the harness assembly since the superelevation mechanism is in the ballistic cam housing (fig. 86).

## 360. Installation of Range Shaft Assembly

*a.* Grease and drive a 1/8 x 1/2 straight pin (fig. 95) and a 1/8 x 3/8 straight pin into the mounting surface of the ballistic correction differential assembly and one 1/8 x 1/2 straight pin into the main housing at the left end.

*b.* Position the right end of the range shaft assembly on the ballistic correction differential assembly, locating on the straight pins. Mesh the spur gear teeth of both assemblies and secure the assemblies with four No. 10 x 1/2 fillister-head screws and No. 10 lock washers. Replace the taper pin which had been removed as explained in paragraph 358*c*.

*c.* Position the left end of the shaft assembly on the main housing, locating on the straight pin. Secure it with two No. 10 x 1/2 fillister-head screws and two lock washers.

## 361. Installation of Superelevation Differential Assembly

Drive two 1/8 x 5/8 straight pins (fig. 94) into the main housing. Position the superelevation differential assembly on the housing, locating on the straight pins. Mesh the gear teeth with the range shaft gear teeth and secure the assembly to the housing by three No. 10 x 5/8 fillister-head screws and three No. 10 lockwashers.

### 362. Installation of Neutral Filter Assembly

Drive two 1/8 x 5/8 straight pins (fig. 92) into the main housing. Position the stop and the neutral filter assembly on the main housing, locating on the straight pins. Secure the stop and neutral filter assembly to the housing with two No. 10 x 9/16 fillister-head screws and two No. 10 lockwashers.

### 363. Installation of Compensator Assembly

Drive two 1/8 x 5/8 straight pins (fig. 91) into the range drive assembly. Position the compensator assembly on the drive assembly, locating on the straight pins. Secure the compensator assembly to the drive assembly with three No. 10 x 5/8 fillister-head screws, one No. 10 x 7/8 fillister-head screw, and four No. 10 lockwashers.

### 364. Installation of Left and Right Reticle Lamp Housing Assemblies

*a.* Grease (par. 65*a* and 65*b*) and drive two 1/8 x 1/2 straight pins (fig. 79) into the main housing. Position the left reticle lamp housing assembly, locating on the straight pins. Secure it to the housing with four No. 8 x 9/16 fillister-head screws and No. 8 lockwashers.

*b.* From the inside of the main housing, referring to the wiring diagram (fig. 316), attach the terminal wire to the lamp housing assembly using a No. 5 lockwasher and a No. 5 hex nut.

*c.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing ports. Insert four No. 10 x 1/8 round-point set screws in the sealing ports.

*d.* Grease and drive two 1/8 x 1/2 straight pins into the main housing. Position the right reticle lamp housing assembly on the main housing, locating on the straight pins. Secure it with six No. 8 x 9/16 fillister-head screws and No. 8 lockwashers.

*e.* From the inside of the main housing, referring to the wiring diagram (fig. 316), attach the two terminal wires to the lamp housing assembly securing with two No. 5 lockwashers and two No. 5 hex nuts.

*f.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing ports. Insert eight No. 10 x 1/8 round-point set screws in the sealing ports.

### 365. Installation of Collimator Assembly

*a.* Drive two 1/4 x 5/8 straight pins (fig. 90) into the main housing. Position the collimator assembly in the housing, locating on the straight pins. Secure the assembly to the housing with four 3/8 x 3/4 socket-head cap screws. Mesh the spur pinion (fig. 96) on the ballistic

correction differential assembly with scale rack (fig. 180) on the ammo bore sight and range scale assembly of the collimator assembly. Adjust for backlash of a minimum of 0.002 of an inch.

*b.* Punch out the taper pin from the end of the flexible shaft (fig. 277) attached to the elevation bore sight drive assembly and push the flexible shaft as close as possible to the drive assembly. Slide the other end of the shaft on the lead screw 7632852 of the scale assembly of the collimator assembly and secure the flexible shaft to both assemblies with the two No. 6/0 x 3/8-inch taper pins.

### 366. Installation of Filter Shaft Assembly

*a.* Drive a 1/8 x 5/8 straight pin (fig. 89) into the ballistic correction differential assembly. Position the filter shaft assembly in the main housing locating on the straight pin. Secure the actuating fiber shaft support to the differential assembly housing with two No. 10 x 9/16 fillister-head screws and No. 10 lockwashers.

*b.* Slide the couplings on the neutral filter and the compensator assemblies (figs. 91 and 92) and secure to the assemblies with two No. 6/0 x 7/16-inch taper pins (par. 59*b*).

### 367. Installation of Left Penta Reflector Assembly

Position the penta reflector assemblies (fig. 88) on the main housing and secure each assembly to the main housing with three No. 10 x 1/2 fillister-head screws and No. 10 lock washers.

### 368. Installation of Right Penta Reflector Assembly and Flexible Shafts

*a.* Position the penta reflector assembly (fig. 87) on the main housing and secure it to the main housing with three No. 10 x 1/2 fillister-head screws and three No. 10 lock washers.

*b.* Slide the two flexible shafts on the collimator assembly, but do not secure them to the collimator with taper pins until the telescope assembly has been installed.

### 369. Installation of Ballistic Cam Housing Assembly and Ballistic Cam Housing Cover (T41)

*a.* Drive two 1/4 x 1 straight pins (fig. 85) into the main housing. Position cam housing assembly on the main housing, locating on the straight pins. Check that the contact surfaces are flush within 0.005 inch and mesh the gear teeth with the gear teeth of the superelevation differential assembly. Secure the cam housing to the main housing with seven 5/16 x 3/4 fillister-head screws and 5/16-inch lock washers.

*b.* Screw four No. 8 x 5/8 socket-head cap screws into the main housing through the rear bellows retaining plate and the ballistic cam housing bellows to secure the bellows to the main housing.

*c.* Drive two ¼ x 1 straight pins into the cam housing, position the cover on the cam housing, locating on the straight pins. Secure the cover to the housing with five ¼ x ¾ fillister-head screws and ¼-inch lock washers.

*d.* Secure the bellows plate to the cam housing cover with four No. 8 x ⅝ socket-head cap screws and four No. 8 lock washers.

*e.* Inject noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing ports using the hydraulic injection gun J022–7648134 and the adapter (fig. 12). Screw five No. 10 x ⅛ round-point set screws in the ports in the cam housing and four No. 10 x ⅛ round-point set screws into the ports in the cover.

## 370. Installation of Ballistic Cam Housing and Ballistic Cam Housing Cover (M12)

Follow the same procedure as explained in paragraph 369 except that a cushioned clip which holds the harness assembly is secured to the main housing with a No. 8 x ⅜ fillister-head screw and lock washer (fig. 86).

## 371. Installation of Left Bearing Assembly and Sealing Window Cell Assembly

*a.* Slide the left bearing assembly (fig. 84) on the machined surface of the main housing and secure it by screwing the retainer on the housing using an improvised 6 7/16-inch hook spanner wrench (fig. 49). Screw in the retainer until there is no end play and the bearing turns freely and smoothly on the housing.

*b.* Screw a No. 10 x ¼ flat-point set screw through the retainer to the main housing to fix the position of the retainer.

*c.* Insert the sealing window cell assembly in the main housing. Use snap ring pliers, compress an internal snap ring and release it into the recess in the main housing to hold the window in position.

*d.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the sealing ports to seal the cell assembly in the main housing.

## 372. Installation of Right Bearing Assembly and Sealing Window Assembly

*a.* Use pressure to push down the pawl locking plunger (fig. 83) and slide the right bearing assembly on the machined surface of the main housing.

*b.* Insert the sealing window cell assembly in the main housing. Use snap ring pliers to compress an internal snap ring and release it into the recess in the main housing to hold the window in position.

*c.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the sealing ports to seal the cell assembly to the main housing.

### 373. Installation of Eyepiece Elevation Link, Filter Lever Assembly, and Plug

*a.* Screw a ¼-inch pipe plug (fig. 82) into the main housing and seal the plug in the housing with adhesive sealing compound (par. 67).

*b.* Grease and drive two 3/16 x ½ straight pins intothe main housing. Position the filter lever assembly on the housing, locating on the straight pins. Secure the assembly with three No. 10 x ½ fillister-head screws and No. 10 lock washers.

*c.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing ports. Insert two No. 10 x ⅛ round-point set screws into the sealing ports of the filter lever assembly.

*d.* Hold the eyepiece elevation link in position on the main housing, insert the 0.3748-inch diameter straight pin through the holes in the housing and the link, and secure the link with a No. 10 x 5/16 cup-point set screw through the link to the pin.

### 374. Installation of Lower Front Control Panel Assembly and Adapter Plate Assembly

*a.* Grease and drive two 3/16 x ½ straight pins (fig. 81) into the main housing. Position the adapter plate assembly on the housing, pulling the two wires into the housing. Locate the assembly on the straight pins. Secure the assembly to the housing with nine No. 10 x ⅜ fillister-head screws.

*b.* Attach the two wire terminals to the terminal block of the resistor board assembly with two screws referring to the wiring diagram (fig. 316).

*c.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing ports. Insert 13 No. 10 x ⅛ round-point set screws in the sealing ports.

*d.* Position the lower front control panel assembly on the adapter plate and secure it to the plate with seven No. 5 x ⅜ oval-head screws.

*e.* Position the two bore sight locking levers on the adapter plate assembly through the panel and secure them to the assembly by driving a No. 6/0 x 7/16-inch taper pin through each lever (par. 59*b*) and insert a No. 10 x ⅛ flat-point set screw through the lever to the plate.

### 375. Installation of Scale Transfer Prism Lever Assembly and Reticle Adjustment Housing Assembly

*a.* Grease (par. 65*a* and *b*) and drive two ⅛ x ½ straight pins (fig. 80) into the main housing. Position the reticle adjustment housing assembly on the main housing, locating on the straight pins. Secure

it to the housing with four No. 8 x ½ fillister-head screws and four No. 8 lock washers.

*b.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing ports. Insert two No. 10 x ⅛ round-point set screws in the sealing ports.

*c.* Grease and drive a ⅛ x ½ straight pin into the main housing. Position the scale transfer prism lever assembly on the housing, locating with the straight pin. Secure it to the housing with six No. 10 x ½ fillister-head screws and No. 10 lock washers.

*d.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the sealing ports. Insert two No. 10 x ⅛ round-point set screws into the sealing ports.

### 376. Installation of Serrated Range Knob Sealing Plate and Terminal Board Cover

*a.* Position the terminal board cover (fig. 78) on the main housing and secure it with four No. 8 x 9/16 flat-head screws.

*b.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), insert noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing ports. Insert eight No. 10 x ⅛ round-point set screws in the sealing ports.

*c.* Slide the sealing plate on the range drive shaft. Position the plate, lining up the drilled holes with the threaded holes of the main housing. Secure it to the main housing with three No. 8 x ½ fillister-head screws and No. 8 lockwashers.

*d.* Using hydraulic gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing ports. Insert two No. 5 x ⅛ flat-point set screws close to the shaft and two No. 10 x ⅛ round-point set screws in the sealing ports.

*e.* Tap the 1/16 x ¼ woodruff key into the shaft. Slide the serrated range knob on the shaft and secure the range knob by screwing a 5/16-inch safety nut on the range shaft.

### 377. Installation of Spare Lamp Box Assembly

*a.* Open the cover (fig. 77) of the spare lamp box assembly and position the assembly on the main housing. Secure it to the housing with four No. 10 x 9/16 fillister-head screws and No. 10 lockwashers.

*b.* Insert eight electric lamps in the spare lamp plate and close the cover.

## 378. Installation of Upper Front Control Panel, Halving Knob Assembly, ICS Knob Assembly, and Ballistic Correction Knob Assembly

*a.* Grease and drive eight $\frac{3}{16}$ x $\frac{1}{2}$ straight pins (fig. 76) into the main housing. Position the halving, ICS, and ballistic correction knob assemblies, locating on the straight pins. Secure them to the main housing wth six No. 10 x $\frac{3}{8}$ fillster-head screws.

*b.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) into the injection sealing ports in the knob plates. Screw the No. 10 x $\frac{1}{8}$ round-point set screws into the sealing parts of the knob assemblies.

*c.* Position the upper front control panel on the knob assemblies and secure it with five No. 5 x $\frac{3}{8}$ oval-head screws through the panel to the knob assemblies.

## 379. Adjustment on Superelevation Test Instrument and Synchro Position Indicator

*a. Timing Gear Train.*

*Note.*—The telescope and prism assembly, viewing telescope and link mentioned below are part of the superelevation test instrument 7661030 (fig. 28).

(1) Plug in the connector from the synchro position indicator (fig. 26) to the superelevation test instrument 7661030 (fig. 28).

(2) Attach the telescope and prism assembly (fig. 318) at the end of the collimator assembly with two socket-head screws.

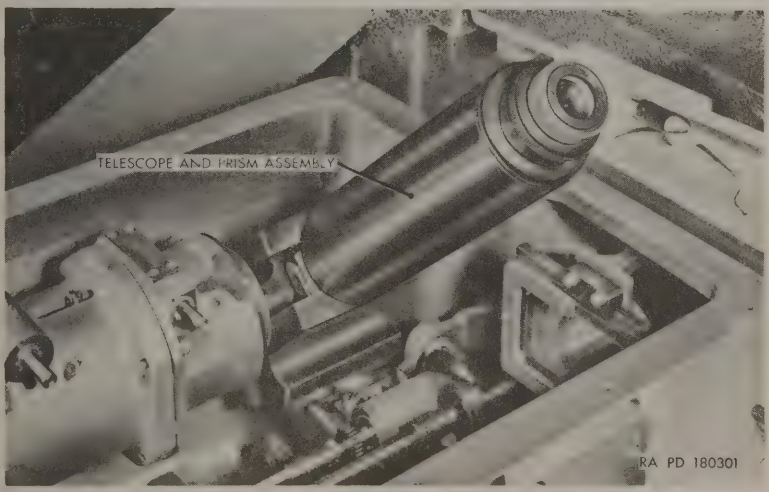


*Figure 318. Installation of telescope and prism assembly.*

(3) Bolt the viewing telescope (fig. 319) to the right end of the housing. Use five hex-head bolts.

(4) Set the range scale to 482 (line below B) by turning the unpinned flexible shaft (fig. 320). The range scale can be read through the telescope and prism assembly.

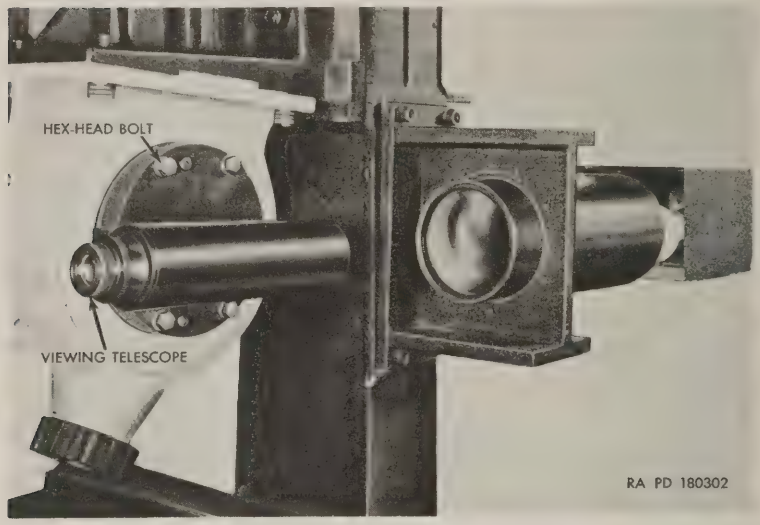


*Figure 319. Installation of viewing telescope.*

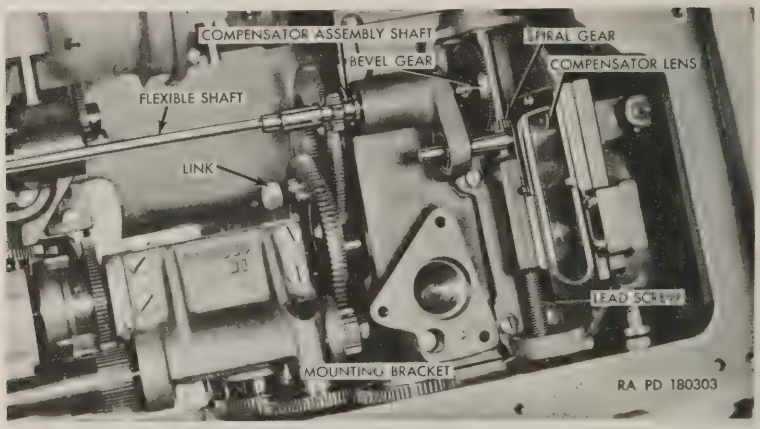


*Figure 320. Timing gear train.*

(5) Turn the range knob as far as it will go in a clockwise direction.

(6) Insert the taper pin in the flexible shaft to the compensator assembly shaft.

(7) Loosen the No. 5 x 1/8 flat-point set screw on the lead screw collar of the range scale (fig. 183).
(8) Insert the link (fig. 320), in the noncircular gears on the range drive, to keep them from turning.
(9) Set the range scale to 482 (line below B) by turning the lead screw collar.
(10) Remove the link, tighten the set screw in the lead screw collar, and set the set screw with orange shellac varnish.
(11) Set the ammo knob (fig. 321) to the approximate center of its full travel. Move the ammo scale to the approximate center position. Look through the viewing telescope to see if the index hits exactly on the figure of the ammo scale. If the figure is not centered on the index, move the ammo scale. Slide the small pinion forward to engage the teeth in the scale rack. If the teeth of the pinion do not engage the teeth of the rack, turn the ammo knob to the next detent and again try to make the pinion teeth mate with the teeth of the rack. Continue this procedure until the pinion and scale rack are in contact.
(12) Check to see if the ammo knob will give full travel from 0 to 90. If it does not give full travel, turn the knob clockwise as far as possible. Loosen the set screw and remove the end screw from the knob. Reset the knob so that the stop (fig. 322) will give a reading of 0 to 90 or an equal reading beyond 0 to 90.
(13) Attach the adjusting link (fig. 323) of the superelevation test instrument to the bracket of the test stand and the cam housing. Disengage the pawl on the right bearing.
(14) Set the ammo scale to "0" and the range scale to "B." Adjust the adjusting link for "0" reading on the mil scale in the viewing telescope (fig. 319).
(15) Set the ammo scale at 60 (55 for the M12) and the range scale to 5,000 yards. Adjust the ballistic correction knob (fig. 321) to read 47.1 on the mil scale. Remove the ballistic correction knob and set the knob so that "0" is opposite the index mark on the plate. Check zero setting on the viewing telescope mil scale.
(16) Using the superelevation check table (table V) as a guide, take readings at 5,000, 4,000, 3,000, 2,000, and 500 with the ballistic correction knob at "0" and the ammo scale at "60" (55 for the M12). Record these readings. If the readings are consistently above the tolerances on the high side, set the ballistic correction knob to a few points below the 47.1 reading. If the readings are consistently lower than the given tolerances, set the ballistic correction knob to read

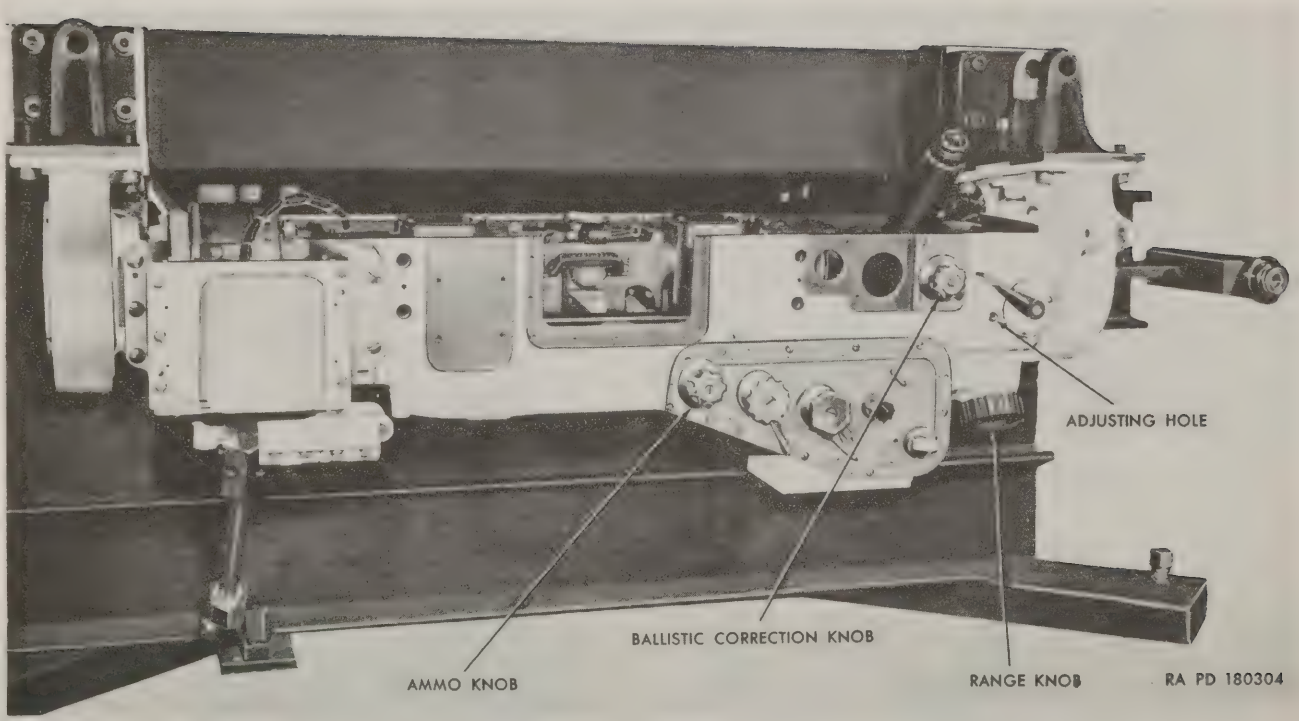


*Figure 321. Range finder controls.*

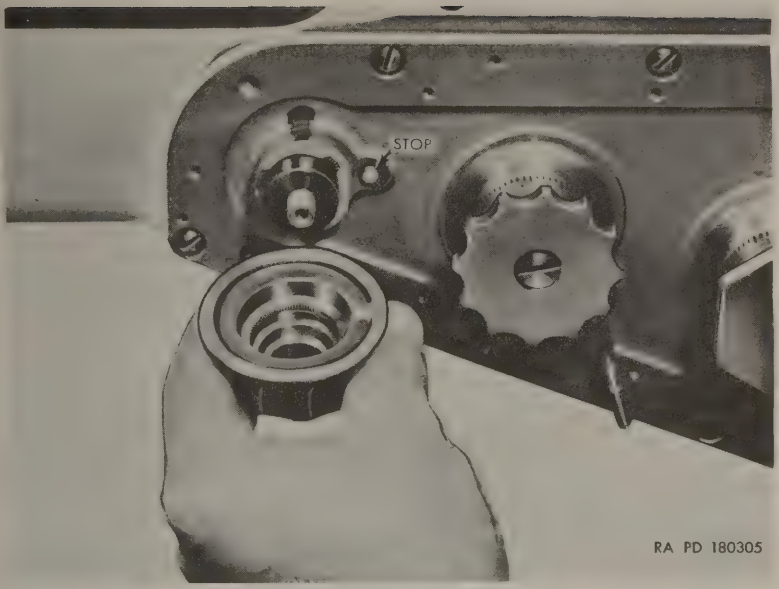


*Figure 322. Ammo knob stop.*

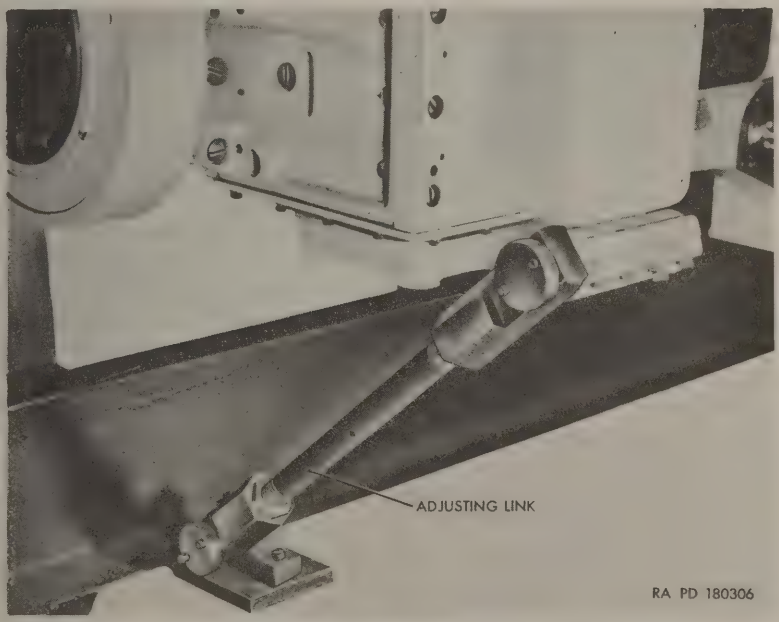


*Figure 323. Adjusting link on superelevation test instrument.*

higher than 47.1. Repeat the readings and continue to reset the ballistic correction knob until the readings are within the given tolerances.

(17) Set the ammo scale as indicated in table V and make the readings at the various ranges. Continue to make these readings and adjustments until they are within the given tolerances.

*Table V. Superelevation Check Table*

| Range (yds.) | Ballistic correction | Ammunition selection for M12 | | | Ammunition selection for T41 | | Tolerance (Mils) |
|---|---|---|---|---|---|---|---|
| | | 40 | 55 | 77 | 60 | 33 | |
| 500 | 0 | | 3. 3 | | 3. 3 | | ±0. 30 |
| 1,000 | 0 | 5. 0 | 6. 3 | 9. 2 | 6. 3 | 5. 0 | +0. 30 |
| 1,500 | 0 | | 10. 1 | | | | ±0. 30 |
| 2,000 | 0 | | 14. 4 | | 14. 4 | | ±0. 30 |
| 2,000 | +15 | 13. 0 | | 26. 1 | | | ±0. 30 |
| 2,000 | −10 | 9. 7 | | 19. 4 | | 9. 7 | ±0. 30 |
| 2,500 | 0 | | 19. 1 | | | | ±0. 40 |
| 3,000 | 0 | | 24. 0 | | 24. 0 | | ±0. 50 |
| 3,000 | +15 | 21. 6 | | 44. 6 | | | +0. 50 |
| 3,000 | −10 | 16. 0 | | 32. 5 | | 16. 0 | ±0. 50 |
| 3,500 | 0 | | 29. 2 | | | | ±0. 60 |
| 4,000 | 0 | | 34. 6 | | 34. 6 | | ±0. 80 |
| 4,500 | 0 | | 40. 5 | | | | ±1. 00 |
| 5,000 | 0 | | 47. 1 | | 47. 1 | | ±1. 40 |

(18) If the compensator lens does not travel from 482 to 5,000 yards, disconnect the bevel gear (fig. 320) and set the range scale at 5,000 yards. Remove the ¼-inch pipe plug (fig. 82). Insert a screw driver through the adjusting hole (fig. 321) and turn the lead screw until the compensator lens is approximately three sixty-fourths of an inch from the mounting bracket. With the compensator lens in this position, engage the bevel gear with the spiral gear and replace the taper pin. Set the pin with orange shellac varnish. Replace the plug in the adjusting hole.

*b. Synchro Test for Electrical Output.*

(1) Turn on the "power switch" of the synchro position indicator (fig. 26) and allow 3 to 5 minutes for warmup.

(2) Turn on the "400 CPS voltage" switch and adjust the power stat ("adjust voltage") for 110-volt dc.

(3) Set the ammo scale to 60 (55 for the M12).

(4) Set the range knob to 500 yards moving it from the "B" position. Set the ballistic knob to "0."

(5) Set the "synchro position" to "0" with the finger wheel adjustment.

(6) Rotate the outer ring of the "synchro position" until the "null meter" is at "0."

(7) Make the readings indicated in table VI and if the readings are not within the given tolerances for the M12, check the wiring or raise or lower the superelevation readings (*a*(16) above).

(8) For the T41, make the readings indicated in table VI and if the readings are not within the tolerance disengage the spur gear of the lower bracket assembly (fig. 324) and set the range at 3,100. Insert a pin in the hole in the bevel gear and aline the pin with the groove in the bracket. Engage the spur gear. Repeat the readings. If the readings still vary slightly from tolerance, shift the spur gear one tooth with the 52-tooth gear.

*Table VI. Electrical Output Table*

| Range (yards) | External synchro-repeater (shaft rotation in degrees) T41 | Allowable tolerance degrees plus or minus T41 | External synchro-repeater (shaft rotation in degrees) M12 | Allowable tolerance degrees plus or minus M12 |
|---|---|---|---|---|
| 500 | Set to zero | 3 | Set to zero | 3 |
| 1,000 | | | 42.90 | 3 |
| 1,100 | 54.56 | 5 | | |
| 1,500 | | | 97.44 | 3 |
| 1,800 | 135.81 | 5 | | |
| 2,000 | | | 159.84 | 4 |
| 2,500 | 228.83 | 6 | | |
| 3,000 | 299.61 | 7 | 297.91 | 5 |
| 4,000 | 92.07 | 12 | 90.56 | 9 |
| 5,000 | 272.36 | 18 | 270.79 | 15 |

*Note.*—Set ballistic knob to "0" and ammo scale at 60 (55 for the M12).

## 380. Installation of Main Telescope Assembly

*a.* Grease and drive two No. 1/4 x 3/8 straight pins (fig. 75) into the main housing.

*b.* Lower the main telescope assembly into the main housing, keeping the tube as far from the front of the housing as possible. Pull the assembly forward to position the mounting bearings of the tube on the two straight pins. Secure it to the main housing with four 3/8 x 7/8 socket-head cap screws through the main housing to the mounting bearings.

*c.* Position the eyepiece elevation link on the lower housing of the telescope, drive a 0.3748-inch diameter straight pin through the telescope housing and the link. Secure the straight pin with a No. 10 x 5/16 cup-point set screw through the link to the pin.

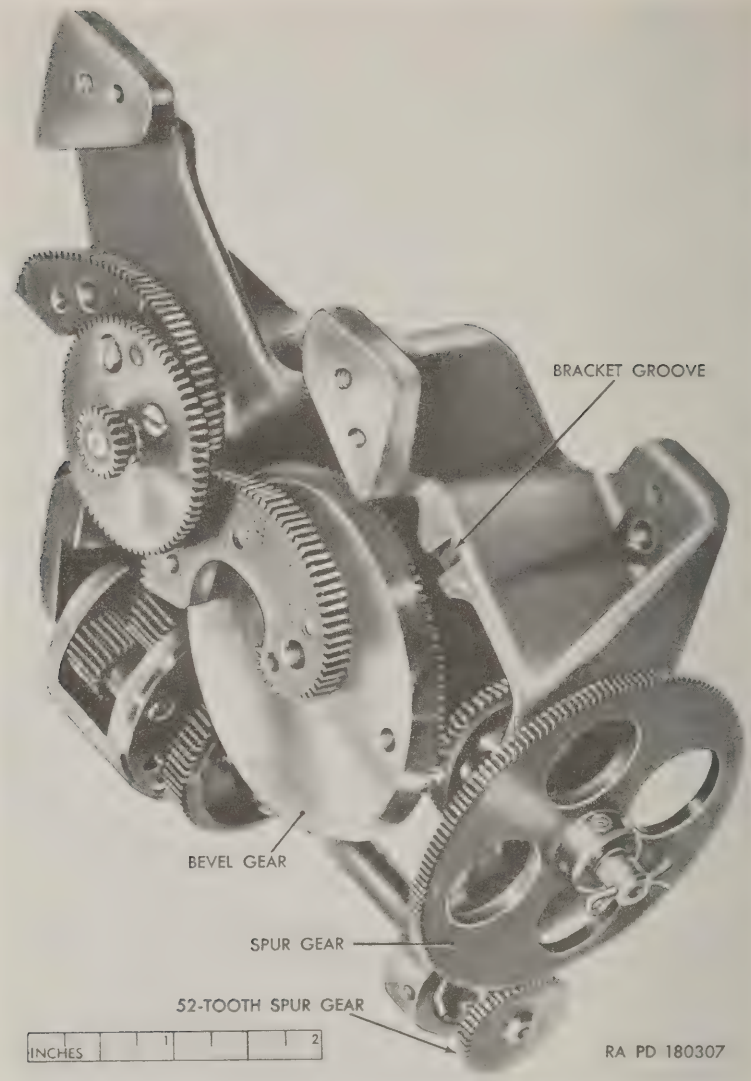


*Figure 324. Adjusting lower bracket assembly to bring T41 within electrical output tolerances.*

*d.* Secure the bellows rim and the bellows to the main housing with nine No. 10 x ½ oval-head screws.

*e.* Push the two flexible shafts as far as possible on the collimator assembly and slide the couplings at the other end on the ICS and the halving shafts of the telescope assembly in their normal position.

Secure the flexible shafts by driving four No. 6/0 x 3/8-inch taper pins (fig. 87) through the flexible shaft couplings and telescope and collimator shafts (par. 59*b*).

### 381. Installation of Lubrication Decalcomania, Upper and Lower Link Connector, Lower Link Connector Rods, and Ammo Plate

*a.* Paste the lubrication decalcomania (fig. 74) on the upper housing of the telescope assembly.

*b.* Loosen the cap screws, insert the upper link connector assembly into the ballistic cam housing assembly, and tighten the cap screws.

*c.* Loosen the other cap screws, insert the lower link connector assembly into the ballistic cam housing assembly, and tighten the cap screws.

*d.* Screw a left-hand hex jam nut on the upper end of a $9\frac{1}{16}$-inch long rod and a hex jam nut on the lower end of the rod.

*e.* Screw the rod into the lower link connector assembly and lock with the nut.

*f.* Position the ammo data chart on the ballistic cam housing cover (figs. 85 and 86) and secure it with four No. 5 x 3/16 round-head screws.

### 382. Installation of Main Housing Cover, Gasket, and Pipe Plug

*Note.*—The cover must be removed to make final adjustments.

*a.* Grease and drive two 3/16 x 5/8 straight pins (fig. 73) into the main housing cover. Position the gasket in the recess in the main housing cover and position the cover on the main housing and the ballistic cam housing, locating on the straight pins. Secure the cover with 29 No. 10 x 5/8 fillister-head screws and No. 10 lockwashers. Secure the upper part of the bellows and the inner bellows rim to the cover with five No. 10 x 1/2 oval-head screws.

*b.* Using hydraulic injection gun J022–7648134 and the adapter (fig. 12), inject noncuring sealing compound 52–C–3258–500 (par. 68) in two upper sealing ports at each side of the ballistic cam housing assembly, two in the main housing cover above the two in the cam housing, and in two ports at each side of the inner bellows rim.

*c.* Screw a 3/8-inch pipe plug into the main housing cover and then apply adhesive sealing compound 52–C–3257–220 (par. 67) covering the plug.

### 383. Installation of End Housing Assembly

The end housing assembly (fig. 72) is attached to the main housing after the unit is installed in the tank as explained in the installation of the range finder to the on carriage position (par. 415).

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## Section VIII. TESTS AND ADJUSTMENTS

### 384. General Preparation

*a.* Mount the range finder on double collimator 18–C–1279–25, using the brackets (fig. 325), which are a part of the yoke 7658885 (fig. 41).

*b.* Release the pawl on the right bearing.

*c.* Set the range finder at 1,000 yards range.

*d.* Attach power cable from synchro position indicator 7661524 (fig. 26). Turn on power switch and 24-volt supply switch, and adjust rheostat to get meter reading of 24 volts.

*e.* Set the double collimator at 1,000 yards range as indicated in (1) through (3) below.

(1) Release the lock screw and turn the adjusting wheel (fig. 326) until the stop has moved out far enough to permit the position indicator to be set at 1,000. Each offset on the position indicator is marked with a range.

(2) When the 1,000-yard offset is in position, turn in the adjusting wheel until the micrometer dial indicates the value given on the chart.

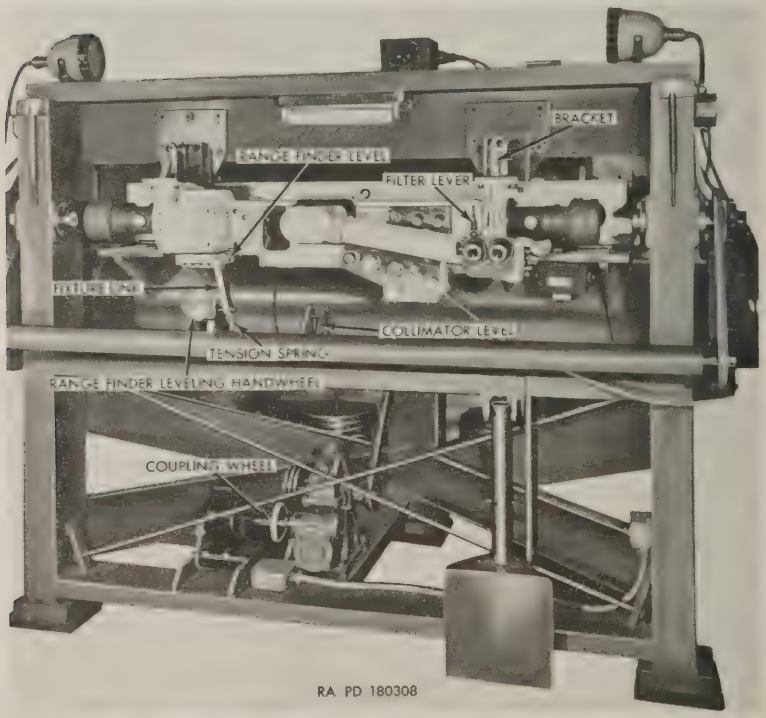


*Figure 325. Range finder mounted in double collimator 18–C–1279–25.*

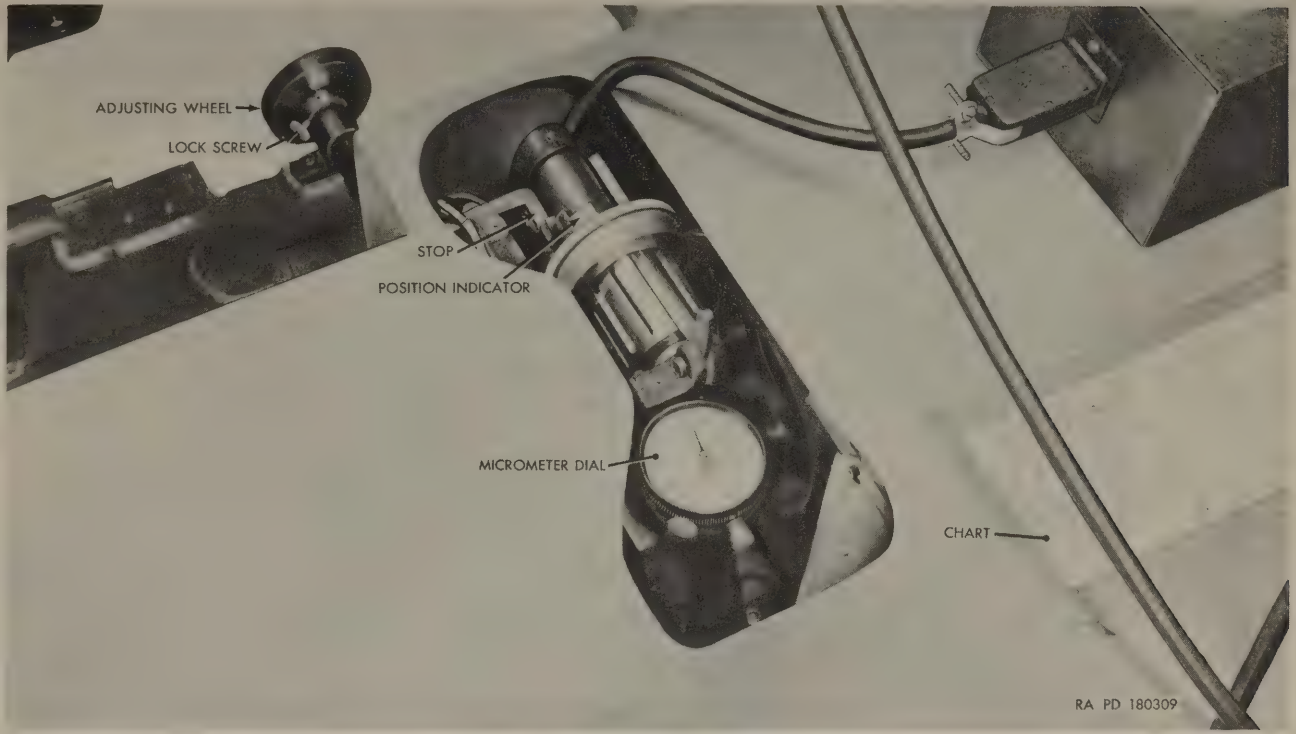


*Figure 326. Setting range on double collimator.*

(3) Each double collimator is supplied with a chart to indicate the dial setting at each given range.

### 385. Focusing Eyepiece

Set the telescope with stand 7661526 on the worktable (fig. 327) with the telescope just close enough to the eyepiece to permit operation

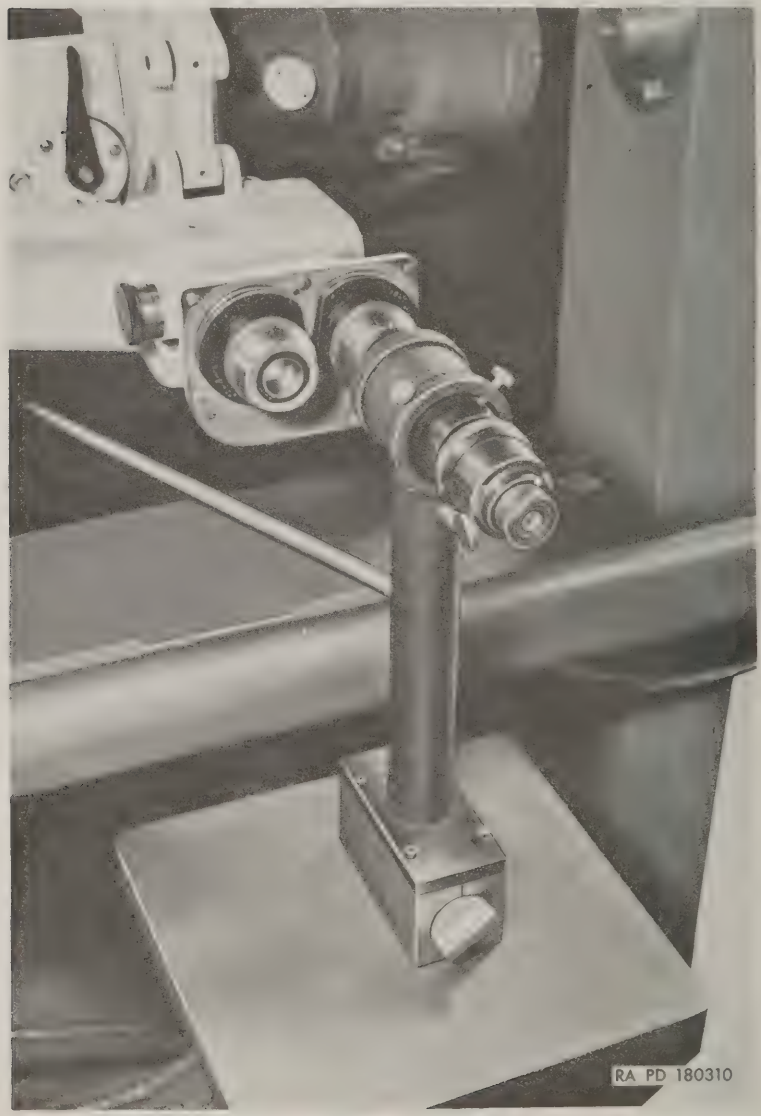


*Figure 327. Telescope with stand 7661526, in position for use.*

of the scales. Set the telescope at "0" reading; then rotate the eyepiece until sharpest focus is obtained. If the scale is not within one-fourth diopter of zero, loosen three No. 2 x 1/8 flat-point set screws (fig. 109), turn the diopter scale to "0", and tighten the three set screws.

### 386. Adjusting Diopter Range

*a.* Check to see if the eyepiece is adjustable over a range of ±3 diopters.

*b.* If the eyepiece does not have this range but has at least 6 diopters total movement with the eyepiece at its mid-point, set the diopter scale to "0" and refocus the erector cell assembly 7632932 (fig. 116). Remove the 1/4 x 3/8 cone-point set screw and use a screwdriver through the erector cell assembly adjusting hole (M, fig. 328). Replace the set screw.

*c.* If the total travel of the eyepiece is less than 6 diopters, disassemble the eyepiece and check for physical interference (par. 125).

### 387. Checking Resolution

*a.* Using the telescope with stand 7661526, look through each eyepiece to see whether the lines in the 6-second resolution pattern can be distinguished (fig. 329).

*b.* If the resolution is not adequate, look for smears on the optical elements of the instrument. Inadequate resolution, not due to dirty optics, may be improved following later adjustments.

### 388. Adjusting for Divergence

*a.* Set the IPD test fixture 7661400 (fig. 25) in front of the eyepiece as shown in figure 330. Adjust the eyepiece diopter for best focus. Adjust the IPD test fixture eyepiece until parallax is eliminated.

*b.* Observe the collimator images with the IPD test fixture. The image of the vertical line from the left target reticle must fall between the images of the vertical lines in the right target reticle (fig. 331).

*c.* To adjust the divergence, remove five No. 8 x 1/2 fillister-head screws and the side telescope cover (fig. 332). Loosen the two socket head cap screws. Insert a punch in the adjusting hole and rotate the 90° prism to the left or right until divergence is within tolerance. Tighten the socket head cap screws.

### 389. Adjusting for Dipvergence

*a.* Using the IPD test fixture 7661400 (fig. 330), view the images and compare their relative positions with the 12-minute tolerance indicated in figure 333. The image of the horizontal line in the left target must fall between the images of two long lines from the right target ± 12 minutes.

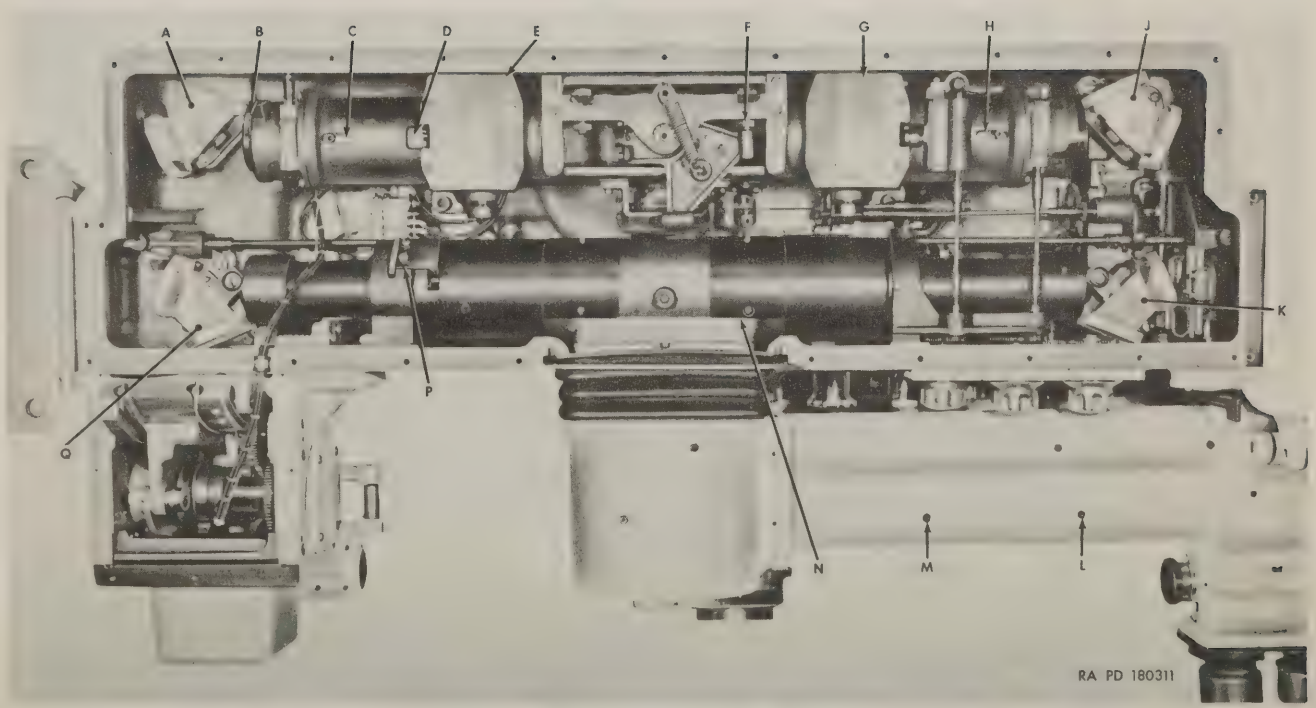


*Figure 328. Range finder M12 with cover removed.*

A—Penta reflector assembly 7632811.
B—Collimator correction wedge cell.
C—Left collimator lens alining assembly.
D—Inner collimator lens cell assembly.
E—Left reticle cover.
F—$\frac{3}{8}$ x $1\frac{7}{16}$ hex-head screw.
G—Right reticle cover.
H—Right collimator lens alining assembly.
J—Penta reflector assembly 7632811.
K—Penta reflector assembly 7649095.
L—Adjusting hole for erector cell assembly 7632933.
M—Adjusting hole for erector cell assembly 7632932.
N—Collective lens cover.
P—Segment gear.
Q—Penta reflector assembly 7649096.

*Figure 328*—Continued.

*Figure 329. Enlarged resolution chart.*

*b.* If adjustment is necessary, loosen the three No. 8 x ½ fillister-head screws (fig. 332) and rotate the prism adjusting eccentric to bring the dipvergence within tolerance. Tighten the three fillister-head screws.

*c.* When both divergence and dipvergence are within tolerance, apply orange shellac varnish and tighten all screws.

## 390. Adjusting for Tilt of Image

*a.* Use the IPD test fixture 7661400 and set the interpupillary adjustment knob at 58 (fig. 330).

*b.* Check the left image for tilt with respect to the horizontal reference marks in the IPD test fixture. Then check the right image in a similar manner. One division difference between right and left readings indicates a 1° tilt of image relative to the target (fig. 334).

*c.* If the tilt is more than 1°, loosen the two No. 10 x ½ fillister-head screws and adjust the segment gear (P, fig. 328) until the tilt is within tolerance. Be sure that the segment gear is pinned before making the vibration test.

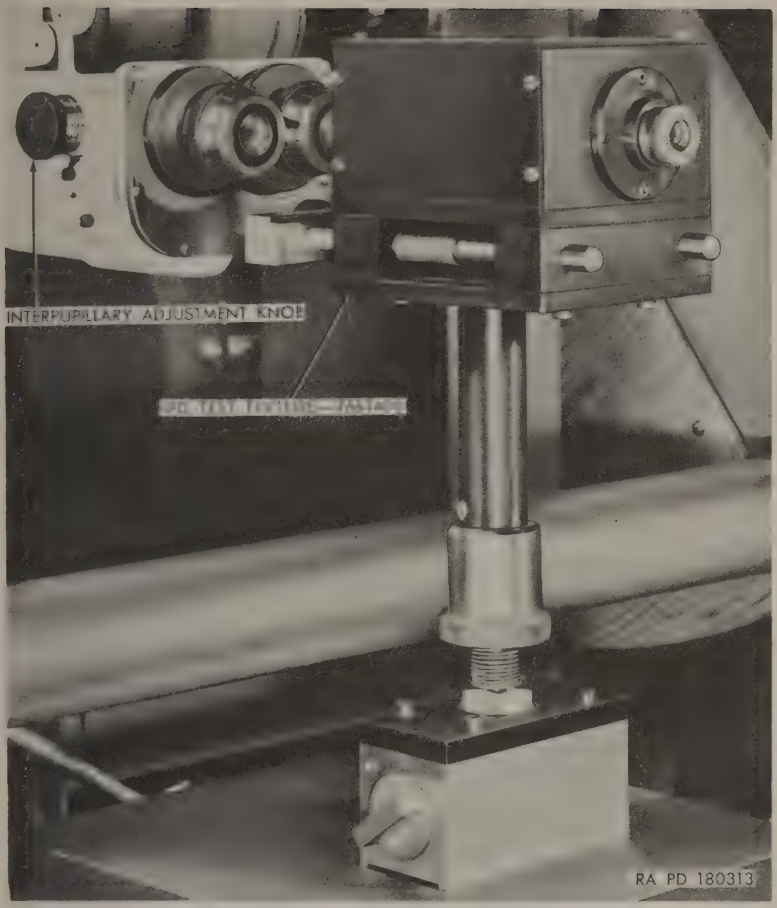


*Figure 330. IPD test fixture in position for use.*

## 391. Adjusting for Parallelism of Target Images

*a.* Use the IPD test fixture 7661400.

*b.* Remove the two No. 8 x ¼ fillister-head screws and the collective lens cover (N, fig. 328).

*c.* Loosen the two No. 10 x 7/16 cup-point set screws (fig. 123).

*d.* Insert a screwdriver through the adjusting hole and by means of the teeth around the circumference of the prism support assembly, rotate the assembly to bring the image parallelism within 30 minutes.

*e.* Tighten the set screws and apply orange shellac varnish.

*f.* Replace the collective lens cover.

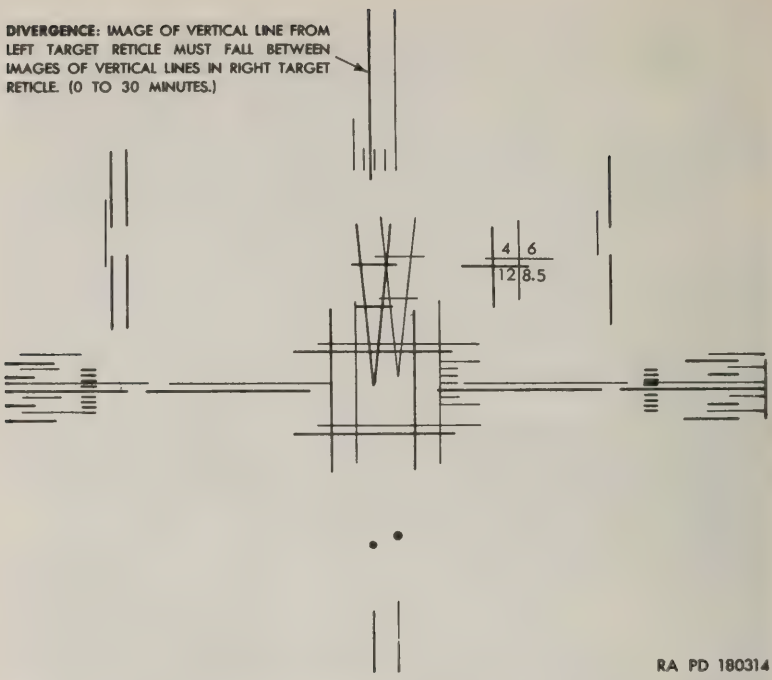
DIVERGENCE: IMAGE OF VERTICAL LINE FROM LEFT TARGET RETICLE MUST FALL BETWEEN IMAGES OF VERTICAL LINES IN RIGHT TARGET RETICLE. (0 TO 30 MINUTES.)
4 6
12 8.5
RA PD 180314

*Figure 331. Reticle pattern for divergence adjustment.*

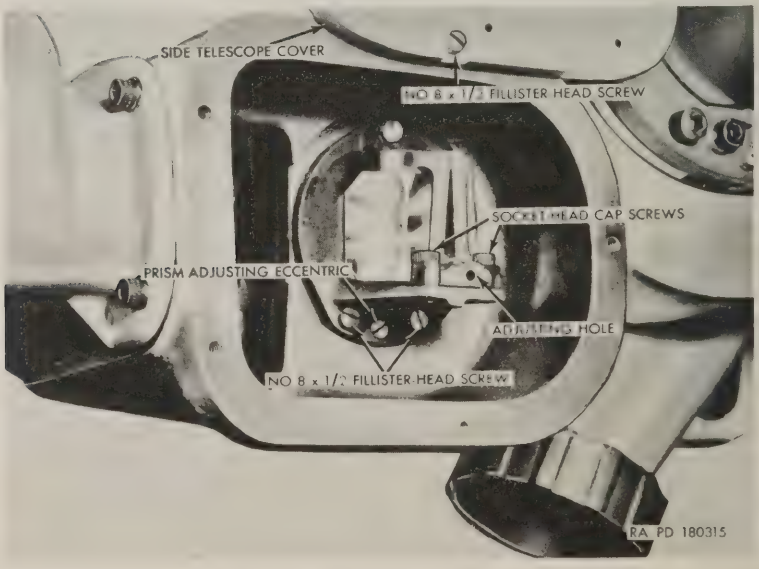
SIDE TELESCOPE COVER
NO 8 x 1/2 FILLISTER HEAD SCREW
SOCKET HEAD CAP SCREWS
PRISM ADJUSTING ECCENTRIC
ADJUSTING HOLE
NO 8 x 1/2 FILLISTER-HEAD SCREW
RA PD 180315

*Figure 332. Adjusting 90° prism.*

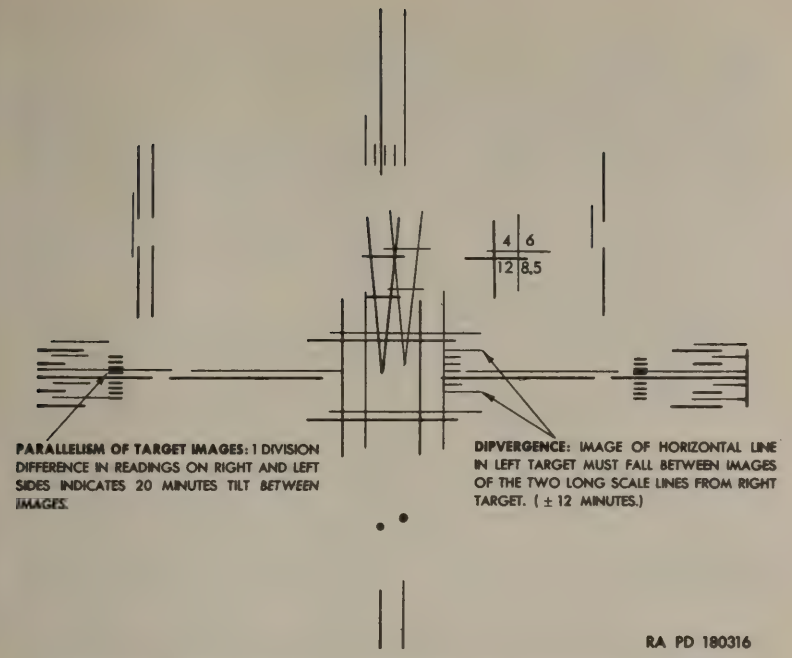
4 6
12 8.5
PARALLELISM OF TARGET IMAGES: 1 DIVISION DIFFERENCE IN READINGS ON RIGHT AND LEFT SIDES INDICATES 20 MINUTES TILT BETWEEN IMAGES.
DIPVERGENCE: IMAGE OF HORIZONTAL LINE IN LEFT TARGET MUST FALL BETWEEN IMAGES OF THE TWO LONG SCALE LINES FROM RIGHT TARGET. ( ± 12 MINUTES.)
RA PD 180316

*Figure 333. Reticle pattern for parallelism and dipvergence adjustment.*

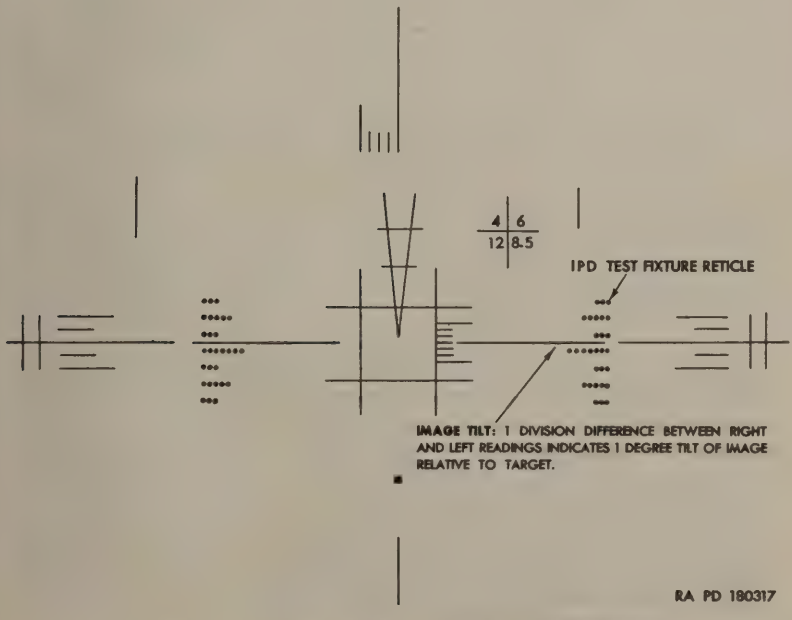
4 6
12 8.5
IPD TEST FIXTURE RETICLE
IMAGE TILT: 1 DIVISION DIFFERENCE BETWEEN RIGHT AND LEFT READINGS INDICATES 1 DEGREE TILT OF IMAGE RELATIVE TO TARGET.
RA PD 180317

*Figure 334. Reticle pattern for image tilt adjustment.*

## 392. Adjusting for Equality of Magnification

*a.* Use the IPD test fixture 7661400.

*b.* Check the equality of magnification of the two sides of the range finder (fig. 335). The single line of the right target image must be between lines of the left image or in coincidence with one pair of lines.

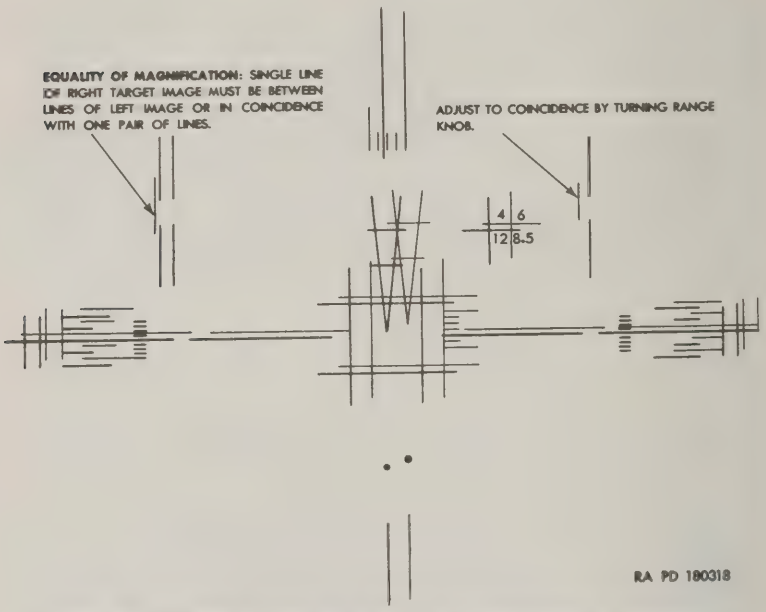
EQUALITY OF MAGNIFICATION: SINGLE LINE OF RIGHT TARGET IMAGE MUST BE BETWEEN LINES OF LEFT IMAGE OR IN COINCIDENCE WITH ONE PAIR OF LINES.
ADJUST TO COINCIDENCE BY TURNING RANGE KNOB.
4 6
12 8.5
RA PD 180318

*Figure 335. Reticle pattern for equality of magnification adjustment.*

*c.* If the magnifications are not within one percent of being equal, remove the ¼ x ⅜ cone-point set screws from the erector cell assembly adjusting holes (L and M, fig. 328), insert a small screwdriver through the adjusting holes, and rotate erector cell assembly 7632932. To increase magnification, move the erector cell assembly toward the eyepiece assembly. When this erector cell assembly has been turned about one full turn, or 40 notches around the periphery of the cell, bring the image back into focus by rotating the erector cell assembly 7632933. This adjustment must be made without any readjustment of the eyepiece. Judge the position of best focus by watching for maximum sharpness in the resolution test patterns in the collimator image. If magnification is still not within tolerance, repeat the adjustment. Check divergence (par. 388) and dipvergence (par. 389) and if necessary, adjust.

## 393. Adjustment for Stereo Reticle Halving

*a.* Set the ballistic correction scale and the ammo scale to "0" and range scale to "B." Use the range finder leveling handwheel (fig. 325) and the range finder level to level the range finder. Use the coupling wheel and the collimator level to level the collimator.

*b.* Set the halving knob to the center of its travel.

*c.* Adjust the penta reflector assembly 7649096 (Q, fig. 328) to bring the lower end of the central range mark to the same height as the lower end of the upper vertical crossline of the target reticle as shown in figure 336.

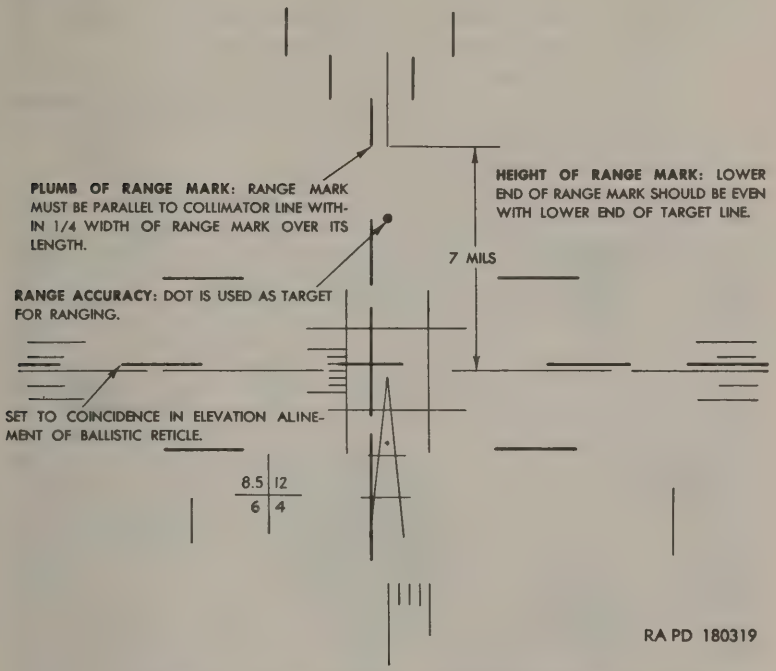
PLUMB OF RANGE MARK: RANGE MARK MUST BE PARALLEL TO COLLIMATOR LINE WITHIN 1/4 WIDTH OF RANGE MARK OVER ITS LENGTH.
HEIGHT OF RANGE MARK: LOWER END OF RANGE MARK SHOULD BE EVEN WITH LOWER END OF TARGET LINE.
7 MILS
RANGE ACCURACY: DOT IS USED AS TARGET FOR RANGING.
SET TO COINCIDENCE IN ELEVATION ALINEMENT OF BALLISTIC RETICLE.
8.5 12
6 4
RA PD 180319

*Figure 336. Reticle pattern for halving adjustment.*

*d.* When the elevation bore sight adjustment has been made, the range mark will be seven mils above the ballistic reticle in the field of view.

## 394. Adjustment for Alinement of Ballistic Reticle Images

*a. Elevation.*

(1) Level the range finder and collimator assembly (par. 393*a*).

(2) Set the ballistic correction knob to "0," the ammo scale to "0," and the range scale to "B."

(3) Set the elevation bore sight knob to the center of its travel.

(4) Rotate the scale on the elevation bore sight knob until the number three is opposite the index mark.
(5) Turn the scale transfer prism lever (fig. 337) so that the ballistic reticle appears in the left eyepiece.
(6) Loosen the No. 10 x 3/8 cone-point set screws on the elevation bore sight knob. Hold the knob at its midposition and rotate the shaft with a screwdriver until the central cross of the ballistic reticle is within one mil of the horizontal line of the collimator image.
(7) Tighten the set screws in the knob.

*b. Tilt.*

(1) Set the scale transfer prism lever (fig. 337) so that the ballistic reticle appears in the left eyepiece.
(2) Observe the angular orientation of the ballistic reticle with respect to the target reticle. One division difference between positions of the ballistic reticle on the left and right sides indicates a 43-minute tilt (fig. 338).

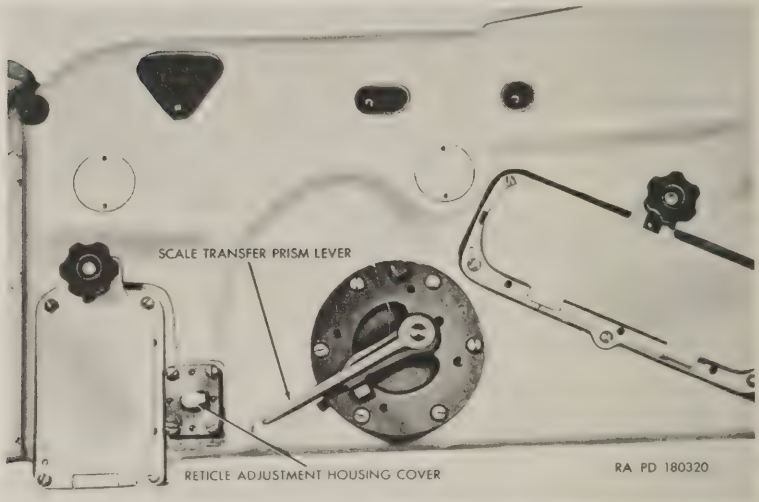


*Figure 337. Bottom view of range finder.*

(3) If tilt of the ballistic reticle is not within this tolerance, tilt the left penta reflector assembly 7632811 (J, fig. 328) by means of the adjusting screw. After the adjustment is made, apply orange shellac varnish to the head of the screw.
(4) Again check elevation (par. 394*a*).

*c. Azimuth.*

(1) Set the scale transfer prism lever (fig. 337) so that the ballistic reticle appears in the left eyepiece.

(2) Set the azimuth bore sight knob to the middle of its travel and with the knob in this position, adjust the scale to read three mils.
(3) Loosen the No. 10 x 3/8 cup-point set screws in the knob.
(4) Hold the azimuth bore sight knob in midposition and with a screwdriver turn the azimuth bore sight shaft until the cross of the ballistic reticle is centered left to right on the collimator reticle pattern. The tolerance on this setting is ±1 mil (fig. 336).
(5) Tighten the set screws in the knob.

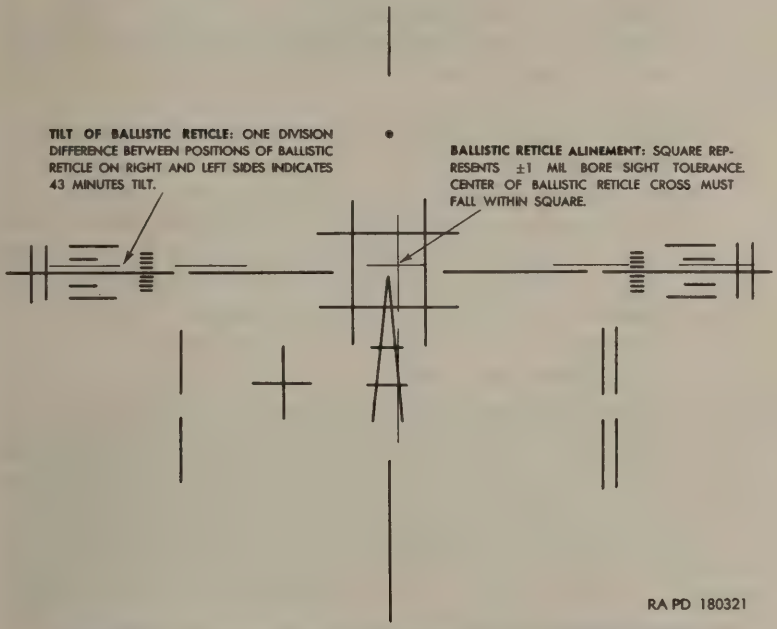
TILT OF BALLISTIC RETICLE: ONE DIVISION DIFFERENCE BETWEEN POSITIONS OF BALLISTIC RETICLE ON RIGHT AND LEFT SIDES INDICATES 43 MINUTES TILT.
BALLISTIC RETICLE ALINEMENT: SQUARE REPRESENTS ±1 MIL BORE SIGHT TOLERANCE. CENTER OF BALLISTIC RETICLE CROSS MUST FALL WITHIN SQUARE.
RA PD 180321

*Figure 338. Reticle pattern for adjustment of tilt of ballistic reticle.*

## 395. Adjusting for Coincidence of Ballistic Reticle Images

*a. Elevation.*

(1) By means of the range finder leveling handwheel (fig. 325) on the double collimator, adjust the elevation of the range finder to bring the horizontal line of the ballistic reticle into coincidence with the horizontal line of the left target image (fig. 336).
(2) Move the scale transfer prism lever (fig. 337) to bring the scales and ballistic reticle image into the right eyepiece.
(3) By means of the adjusting screws on the penta reflector assembly 7649095 (K, fig. 328), tilt the penta reflector assembly

to bring the central cross of the ballistic reticle to the same height as the horizontal line of the target image.

*b. Tilt.*

(1) Adjust the right penta reflector assembly 7632811 (J, fig. 328) to bring the ballistic reticle image within 43 minutes of the same orientation as the target image (fig. 338).

(2) Check elevation of the ballistic reticle and adjust if necessary (par. 395*a*). The ballistic reticle, when seen successively in the left and right eyepiece, should come to the same position relative to the target reticle within 0.2 mil as measured on the elevation bore sight scale.

(3) When both of the right-hand penta reflectors have been properly set, apply orange shellac varnish to the adjusting screws.

*c. Azimuth.*

(1) Set the range finder and the double collimator assembly to the same range.

(2) In the right eyepiece observe the position of the vertical line of the ballistic reticle. If it is not within 0.2 mil of its position when seen in the left eyepiece, adjust the right No. $\frac{3}{8}$ x $1\frac{7}{16}$ hex-head screw (F, fig. 328) on the beam-splitter stop bracket.

(3) Be sure that the jam nut on the hex-head screw is tight when the adjustment is complete.

## 396. Adjusting Height of Stereo Reticle

*a.* Set the scale transfer prism lever (fig. 337) so that the ballistic reticle will be seen in the left eyepiece. With the scale transfer prism in this position, the stereo reticle image will be seen in both eyepieces.

*b.* Set the elevation bore sight knob to three, and with the leveling handwheel (fig. 325) of the double collimator, bring the central horizontal line of the ballistic reticle to coincidence with the horizontal crossline of the target reticle.

*c.* Insert a screwdriver through the opening covered by the reticle adjustment housing cover (fig. 337) and adjust the height of the stereo reticle seen in the right eyepiece until the lower end of the central range mark is seven mils above the central horizontal line of the ballistic reticle (fig. 336).

## 397. Adjusting for Parallax of Ballistic Reticle

*a.* View from the extreme left of the eyepiece and move the ballistic reticle until the bore sight mark falls on intersection "A" as shown in figure 339. Move the eye from the left position to the extreme right of the eyepiece and observe the apparent shift of the bore sight mark relative to the target image. The left side of this mark must remain between intersection "A" and "B" or "A" and "C."

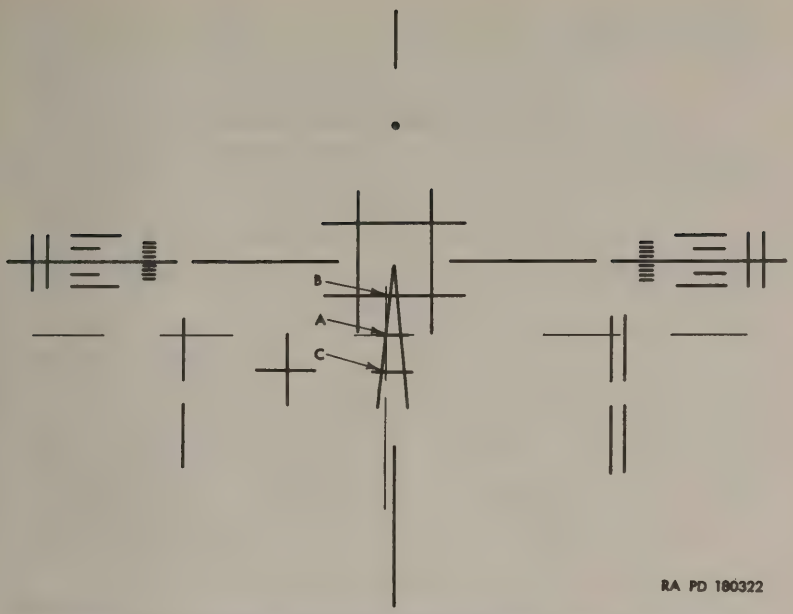


*Figure 339. Reticle pattern for parallax of ballistic reticle adjustment.*

*b.* If adjustment is necessary, adjust the left collimator lens alining assembly (C, fig. 328) for the left eyepiece and the right collimator lens alining assembly (H, fig. 328) for the right eyepiece.

*c.* To make this adjustment, loosen the four No. 10 x $\frac{3}{16}$ cup-point set screws (fig. 173) and by means of the slotted stud, slide the collimator lens alining assembly to right or left.

*d.* When the adjustment is complete, tighten the set screws and apply orange shellac varnish.

## 398. Adjusting Length of Horizontal Ballistic Reticle Line

*a.* Ends of the ballistic reticle line must fall within gates at each side, 40 mils ±1. The distance between the two inside gate lines (fig. 340) is 39 mils and the distance between the lines in each gate is 1 mil.

*b.* See paragraph 290*b* for adjustment.

## 399. Adjusting for Parallax of Stereo Reticle Images

*a.* Set the double collimator assembly at 1,000 yards. See paragraph 384*e*.

*b.* Attach the head rest 7661780 (fig. 33) to the eyepiece as shown in figure 341 and adjust for the normal IPD of the operator.

*c.* Move the aperture mask (fig. 341) so that the target is viewed from the centers of the exit pupils, catch the pawl, and rotate the

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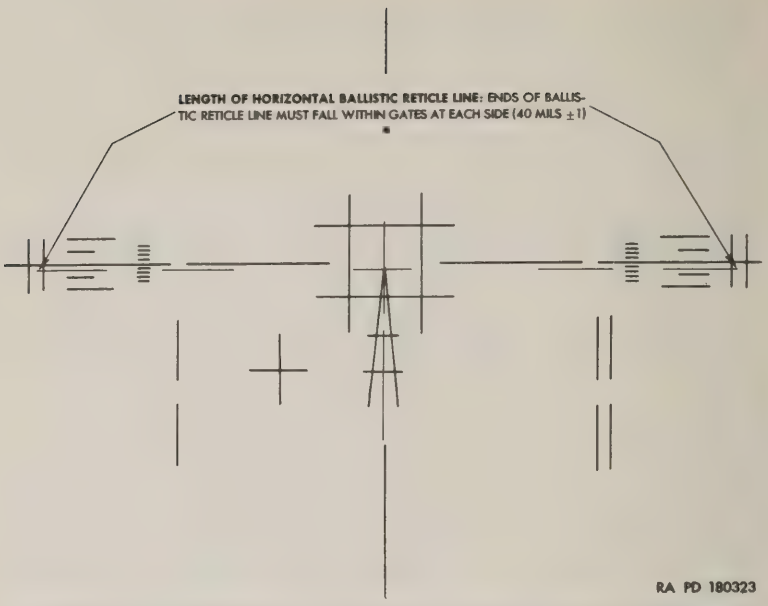
LENGTH OF HORIZONTAL BALLISTIC RETICLE LINE: ENDS OF BALLISTIC RETICLE LINE MUST FALL WITHIN GATES AT EACH SIDE (40 MILS ±1)
RA PD 180323

*Figure 340. Reticle pattern for length of ballistic reticle line adjustment.*

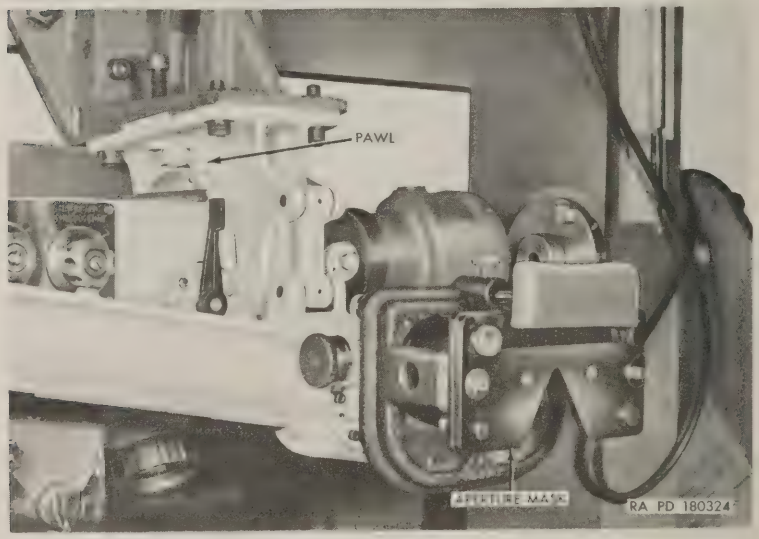


*Figure 341. Head rest 7661780 in position for use.*

fixture link (fig. 325) out of contact with the fixture guide block.

*d.* Make five range readings with and without filters and make a note of the median of the readings of each group.

*Note.*—The filter lever controls the position of the filter.

*e.* Move the aperture mask so that the target is viewed from the right side of the exit pupil and take five range readings with and without the filters and record the median.

*f.* Move the aperture mask so that the target is viewed from the left side of the exit pupil and make five readings with and without filters.

*g.* Make similar readings with the target viewed from the top and bottom of the exit pupil.

*h.* Change the interpupillary knob setting to 2 mm greater than normal. Move aperture mask to center position so that target is viewed from the inner edges of the exit pupils. Then repeat the procedures given in *d* above.

*i.* The tolerances are indicated in (1) through (3) below.

(1) Vertical motion—3 UOE.
(2) Horizontal motion—3 UOE.
(3) Normal IPD +2 mm—2 UOE.

*Note.*—UOE at 1,000 yards=4.65 yards.

*j.* If tolerances are not met, proceed as indicated in (1) through (8) below.

(1) An apparent stereo displacement exists between the target image and the stereo reticle when the optical beams from the target to the eyes include an angle which is different from the angle included by the beams from the stereo reticle post. This is shown in figure 342. If these two angles are made equal as in (*b*) above, the target of the stereo reticle post appears stereoscopically at the same distance from the observer.

(2) The direction of the beam from the stereo reticle (fig. 342) to the left eye was changed by rotating the collimator correction wedge cell (B, fig. 328) at the left end of the collimator assembly. Stereo contact could have been obtained by changing the direction of the beam from the stereo reticle to the right eye by rotating the collimator correction wedge cell at the right end of the collimator assembly. In the latter case, the apparent lateral separation between target and reticle would have been less when stereo contact had been obtained.

(3) If in either eyepiece there is a change in the lateral separation of the target and reticle as the observer's eye is moved to one side of the exit pupil (parallax between the target and reticle), there will also usually be a change in the stereo

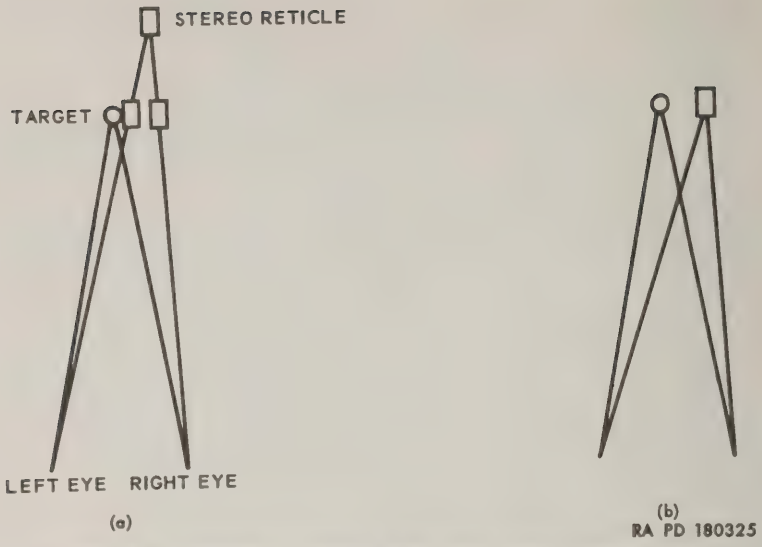


*Figure 342. Schematic drawing of parallax of stereo reticle images.*

relationship of the target and reticle. The result of this condition is that range readings taken with the observer's eye at the edge of the exit pupils will differ from range readings taken with the eyes centered in the pupils. If there is exactly the same amount of parallax in the same direction as seen in both eyepieces, the range readings will not change as the observer's eyes are moved across the exit pupils. However, a change in range readings will result when the IPD change, since this will cause the observer to use the left side of one exit pupil and the right side of the other.

(4) Suppose, for example, that the range readings are too short when the observer's eyes are at the left side of the pupil. In this case, if the range scale is set for the *correct* range reading, the stereo reticle will appear *farther* away than the target. This situation is shown in figure 343. As indicated in this figure, the range error could be caused by either "with" parallax in the left field of view or "against" parallax in the right side. "With" parallax as used here means that the stereo reticle appears to move relative to the target in the same direction as the eye. "Against" parallax means that the stereo reticle appears to move in a direction opposite to that in which the eye moves.

(5) It may be possible to determine by observation where the parallax is and what must be done to correct it. If not, take

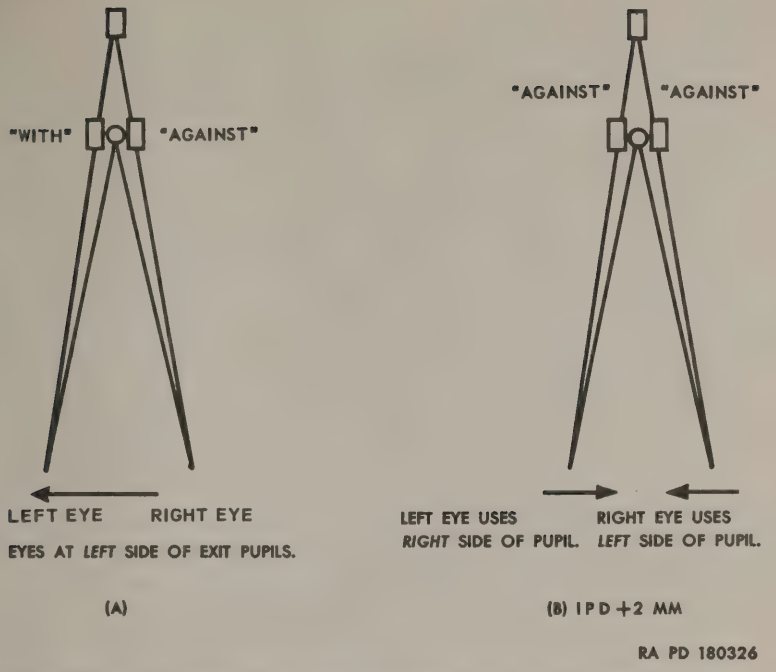


*Figure 343. Schematic drawing illustration "with" and "against" parallax.*

range readings with the IPD increased 2 mm over the observer's normal IPD. This is shown in figure 343. In this illustration, the observer's left eye uses the right side of the exit pupil, simulating the movement of the left eye to the right and right eye to the left.

(6) If the range readings are again short of the correct value, then the stereo reticle must appear too far away, a condition caused by a decrease in the angle included between the two beams which in turn is caused by "against" parallax in either field. However, since it is indicated in figure 343, that the instrument has either "with" parallax on the left side or "against" parallax on the right, it is now possible to eliminate the possibility of "with" parallax on the left side and conclude that the condition to be corrected is an excessive amount of "against" parallax on the right side. Using table VII, similar conclusions can be reached in the other possible combinations of conditions involving side to side parallax.

(7) If the range finder has an excessive range error when the observer's eyes are moved up or down relative to the exit pupils, the cause is a side to side movement of the stereo reticle. It may be possible to partially correct this condi-

*Table VII. Corrective Adjustments for Stereo Parallax*

| | Range correctly reads short at left side, long at right | Range correctly reads long at left side, short at right | Range correctly reads both right and left |
|---|---|---|---|
| RANGE CORRECTLY READS SHORT AT IPD+2MM. | Focus stereo reticle to give more "with" parallax relative to target in *right* eyepiece. | Focus stereo reticle to give more "with" parallax relative to target in *left* eyepiece. | Focus stereo reticles for more "with" parallax relative to target in both eyepieces. |
| RANGE CORRECTLY READS LONG AT IPD+2MM. | Focus stereo reticle to give more "against" parallax relative to target in *left* eyepiece. | Focus stereo reticle to give more "against" parallax relative to target in *right* eyepiece. | Focus stereo reticle for less "with" parallax relative to target in both eyepieces. |
| RANGE CORRECTLY READS AT IPD+2MM. | Focus stereo reticles to give more "with" parallax relative to target in *right* eyepiece *and* more "against" parallax relative to target in *left* eyepiece. | Focus stereo reticles to give more "against" parallax relative to target in *right* eyepiece *and* more "with" parallax relative to target in *left* eyepiece. | Parallax of stereo reticle images is within tolerance. |

tion by a focusing adjustment on the collimator lens alining assembly (par. 397*c*). However, only a small adjustment can be made without introducing excessive parallax when the eyes are moved from side to side.

(8) If the above adjustment is not sufficient, loosen the two No. 10 x 5/16 cone-point set screws (fig. 198) and then rotate the inner collimator lens cell assembly (D, fig. 328) to a position to minimize the amount of lateral movement of the stereo reticle when the eyes are moved up or down. Do not rotate the cell more than one full turn. After the adjustment is made, tighten the set screws and check the length of the ballistic reticle line (par. 398), the parallax of the ballistic reticle (par. 397), the setting of the diopter scale on the eyepiece (par. 386), and the parallax of the stereo reticle as described in *a* through *j* above.

*k.* If these adjustments fail, proceed as indicated in (1) through (3) below.

(1) Change the two penta reflector assemblies 7649095 and 7632811 (J and K, fig. 328) at the right end of the instrument.

(2) Change the two penta reflector assemblies 7632811 and 7649096 (A and Q, fig. 328) at the left end of the instrument.

(3) Change the end housing assemblies.

## 400. Tilt of Stereo Reticle Images

*a.* If a stereo reticle image is tilted with respect to the target image by more than one-quarter the width of the central range mark (fig. 334) over the length of the mark, the stereo reticle must be rotated.

*b.* Remove the left reticle cover (E, fig. 328) from the collimator housing and loosen the two No. 8 x 1/4 cup-point set screws (fig. 201) that hold the reticle cell assembly in position. Insert a punch in the hole in the reticle cell assembly and rotate it until the image of the central range mark, when viewed through the eyepiece, is parallel to the vertical target lines. Tighten the two set screws, apply orange shellac varnish and replace the reticle cover.

## 401. Adjusting Parallelism of Stereo Reticle Images

*a.* If the stereo reticle images are not parallel, the instrument will read different ranges when the top and bottom of the central range mark are used as references in ranging.

*b.* Use the ICS knob to make five ICS readings with the target dot near the bottom of the range mark and five ICS readings with the dot near the top of the range mark. If the median values of these sets of readings differ more than two UOE, readjustment is necessary. If the median ICS setting is lower when the target dot is at the top of the range mark, the tops of the stereo reticle images are tilted toward each other.

*c.* First tilt the left penta reflector assembly 7632811 (J, fig. 328). If the correction cannot be made this way without throwing the ballistic reticle tilt out of tolerance, rotate the left reticle cell assembly (par. 400*b*).

## 402. Making ICS Scale Setting

*a.* Set the range finder and the double collimator assembly at 1,000 yards (par. 384*e*).

*b.* Set the ICS knob at 25.

*c.* Loosen the two No. 10 x 3/16 cup-point set screws (B, fig. 173) and rotate the collimator correction wedge cell (fig. 328) to obtain stereo contact.

*Note.*—Stereo contact is the point at which the stereo image and the range dot appear to be in the same plane. If there is not sufficient adjustment in the right collimator correction wedge cell, complete the adjustment using the left cell.

*d.* With the range knob set at 1,000 yards, use the ICS knob to range by turning the stereo scale switch to "stereo" and move the ICS knob back and forth until stereo contact is made. Read the UOE scale on the ICS knob. Make this reading five times and record the results. The median of these readings should be within five scale units of 25 on the ICS knob.

## 403. Adjusting for ICS Scale Accuracy

*a.* Set the ICS scale to 25. Make and record five readings by setting the stereo scales switch at "stereo" turning the range finder knob back and forth until stereo contact is made; then turn the stereo scale switch to "scales" and observe the reading.

*b.* Set the ICS scale to "0" and find the median of five range settings as above. The median of these readings should be within the range values indicated in table VIII.

*c.* If the median of the readings does not fall within the indicated range values, loosen the No. 8 x 3/8 fillister-head screw in the ICS knob (fig. 214), loosen the 5/16 slotted round nut, and change the position of the ICS knob relative to its shaft. Repeat the tests.

*d.* Repeat the five reading procedure described in *a* through *c* above with the ICS knob set at 50. If the ICS scale does not read between 20 and 30, repeat the procedure given in paragraph 402.

*e.* Check the ballistic reticle alinement and coincidence as described in paragraphs 394 and 395. Adjust if necessary.

## 404. Adjusting for Range Accuracy

*a.* Engage the pawl (fig. 341) on the right bearing mount.

*b.* Remove the tension spring (fig. 325) from the fixture link.

*c.* Rotate the fixture link out of contact with the fixture guide block.

*Table VIII. Values To Be Used for Checking ICS Knob Accuracy*

| If median range reading at ICS=(25) is— | Then median range reading at ICS=0 should be between— | | And median range reading at ICS=50 should be between— | |
|---|---|---|---|---|
| 975 | 862 | 889 | 1,079 | 1,121 |
| 980 | 866 | 893 | 1,085 | 1,128 |
| 985 | 870 | 898 | 1,091 | 1,135 |
| 990 | 874 | 902 | 1,097 | 1,141 |
| 995 | 878 | 906 | 1,104 | 1,148 |
| 1,000 | 882 | 910 | 1,110 | 1,154 |
| 1,005 | 886 | 914 | 1,116 | 1,161 |
| 1,010 | 890 | 918 | 1,122 | 1,168 |
| 1,015 | 894 | 922 | 1,128 | 1,175 |
| 1,020 | 898 | 927 | 1,134 | 1,181 |
| 1,025 | 901 | 931 | 1,141 | 1,188 |

*d.* Turn the stereo switch to "stereo-scales."

*e.* Manually turn the coupling wheel until the range dot is in a satisfactory position for ranging (as near the bottom of the center stereo post as convenient).

*f.* Set the double collimator assembly at 1,000 yards (par. 384*e*).

*g.* Set the range finder at 1,000 yards.

*h.* Turn the stereo switch to "stereo."

*i.* With the eyes in the same position relative to the eyepiece, range with the ICS knob and record five readings. Determine the median of the readings.

*j.* Set the ICS knob to the median setting.

*k.* Make five range readings with the range knob. Range with the stereo switch at "stereo;" then turn the switch to "scales" and record the reading. The median of those five range values must be within 9.3 yards at 1,000 yards.

*l.* Repeat procedures indicated in *f* through *k* above using ranges of 520 yards and 2,500 yards. The median of the five range values must be within 2.5 yards at the 520-yard setting and within 58 yards at the 2,500-yard setting.

*m.* If the tolerances are not met, check the compensator assembly, the scale assemblies, and the connecting gear train. Inaccurate readings are usually caused by incorrect assembly of parts in these assemblies.

## 405. Checking Electrical Hi-Pot

*a.* Connect the circuit test instrument 7661530 (fig. 27), to an 115-volt, 60-cycle, ac power outlet. Turn on the POWER switch.

*b.* Move the VOLTAGE CONTROL knob to "0."

*c.* Turn the TEST SELECTOR switch and "circuit selector" switch to the OFF position.

*Note.*—Built-in safety interlocks will prevent rotation of these two switches and the VOLTAGE CONTROL to unsafe positions. In addition, these interlocks prevent rotation of any controls unless the POWER switch is turned ON.

*d.* Connect the cable from the circuit test instrument to the range finder receptacle.

*e.* Turn the range finder switch to OFF.

*f.* Turn the TEST SELECTOR switch to STATOR INSULATION BREAKDOWN position.

*g.* Slowly increase the VOLTAGE CONTROL setting until the VOLTAGE TEST meter reads 980 volts, the indicated test value.

*h.* Observe the INSULATION BREAKDOWN indicator and if it is unlit, continue to test for one minute.

*Note.*—Light may flicker but this is not to be considered a defective condition.

*i.* If after one minute the light remains unlit, slowly decrease the voltage to 0.

*j.* If the INSULATION BREAKDOWN indicator does light, replace the synchro torque transmitter. See paragraphs 105 and 167.

## 406. Checking Running Torque of Knobs

*a.* Be sure that the knob locks (fig. 344) are released.

*b.* Use the proper adapter (fig. 40) and make the running torque reading from the torque wrench 7660767. The readings should be as indicated in (1) through (5) below.

(1) Bore sight knobs—not to exceed 10 inch-pounds.

(2) Range knob—not to exceed 16 inch-pounds.

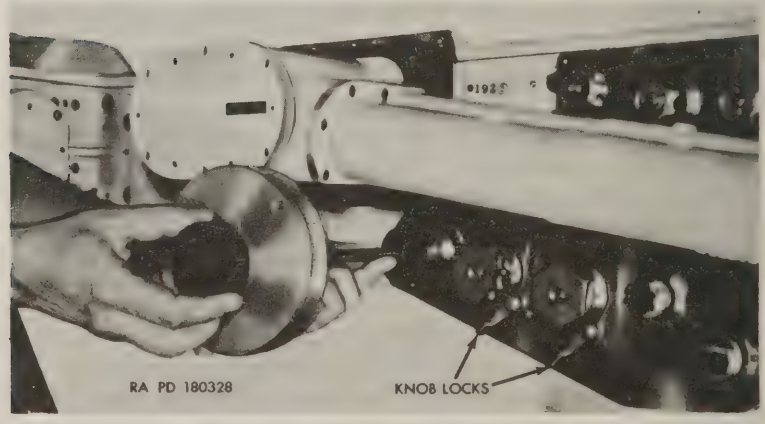


*Figure 344. Checking running torque of knobs.*

(3) Halving, ICS, ballistic correction, and, ammo knobs—not to exceed 8 inch-pounds.
(4) Interpupillary knob—not to exceed 8 inch-pounds.
(5) Diopter adjustment knob—not to exceed 8 inch-pounds.

*c.* If running torque exceeds the indicated limits, remove the upper and lower front control panels (fig. 76 and 81) and check for improper mesh of gears due to run-out and binding shafts.

## 407. Checking Superelevation Accuracy

*a.* Attach the master end box 7661528 (fig. 345) to the right end of the range finder (par. 383).

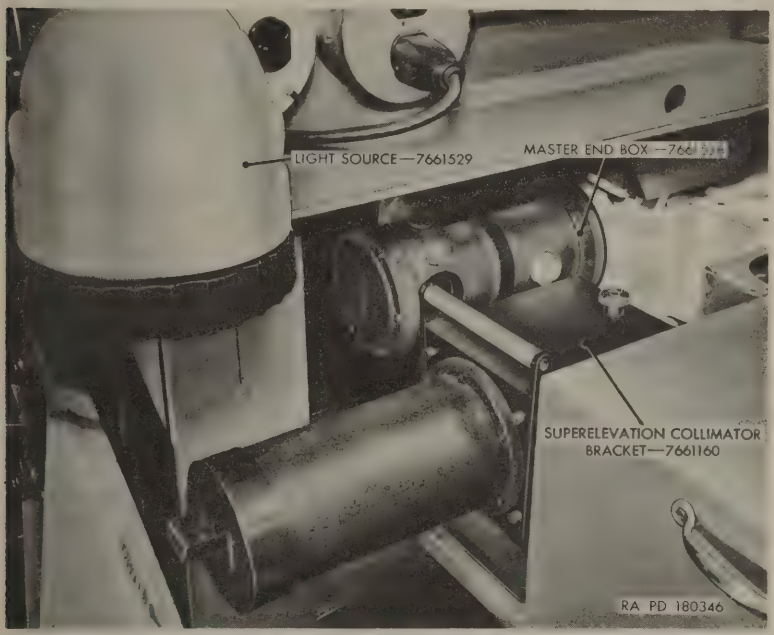


*Figure 345. Superelevation collimator bracket 7661160, master end box 7661528, and light source 7661529 in position for checking superelevation accuracy.*

*b.* Position the superelevation collimator bracket 7661160 on the mounting pads in front of the right end box assembly as shown in figure 345.

*c.* Illuminate the collimator with light source 7661529 as shown in figure 345.

*d.* Move the scale transfer prism lever (fig. 337) to the position nearest the operator.

*e.* Set the ballistic correction and ammo knobs to "0" and the range scale at "B."

*f.* By means of the elevation and azimuth bore sight knobs, move the ballistic reticle until the top of one of the horizontal segments is tangent to the "0" point of the scale seen in the superelevation collimator bracket (fig. 346).

*g.* Lock the elevation bore sight knob.

*h.* Measure superelevation directly in mils at the intersection of the ballistic reticle and the scale for the various range and ballistics cor-

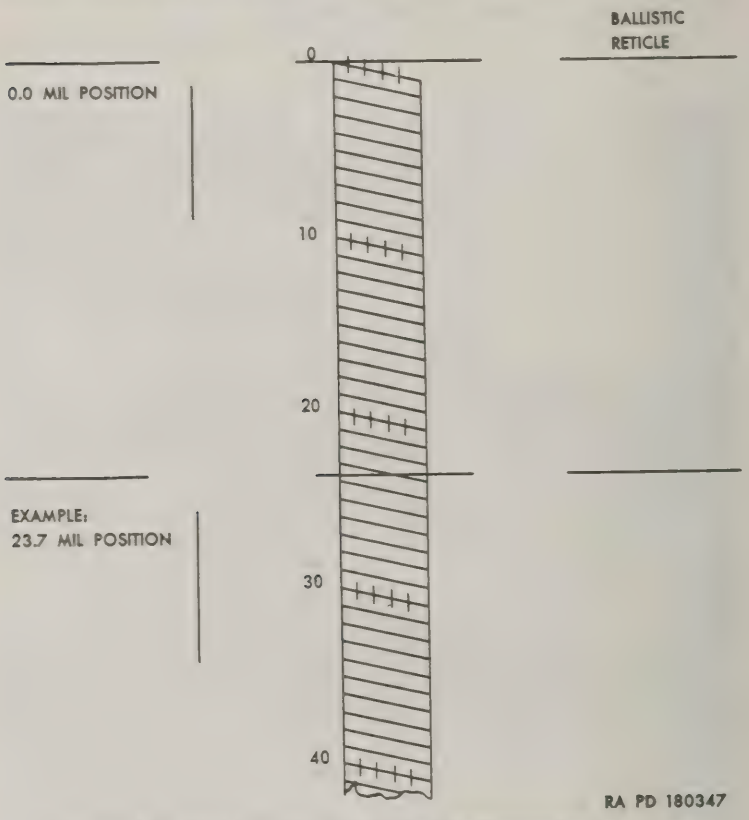


*Figure 346. Reticle pattern for checking superelevation accuracy.*

rection settings shown in table V. Use the intersection of the short vertical scale lines with the 10-mil increment divisions as a vernier. The vertical displacement between each consecutive intersection represents 0.2 mil.

*Note.*—The azimuth bore sight knob can be used during the test if it is necessary to shift the ballistic reticle laterally.

*i.* If adjustment is necessary, see paragraph 379.

## 408. Checking Evenness of Light Transmission and Illumination

*a.* Connect the visual telephotometer 7661575 (fig. 35) and the light source 7661516 (fig. 13) into the central outlet on the back of the double collimator assembly.

*b.* Turn on the light source and position the telephotometer so as to look directly into the center of the light.

*c.* Adjust the telephotometer scale (fig. 347) until the spot blends with the annular ring. Take three readings and determine the average of these three readings.

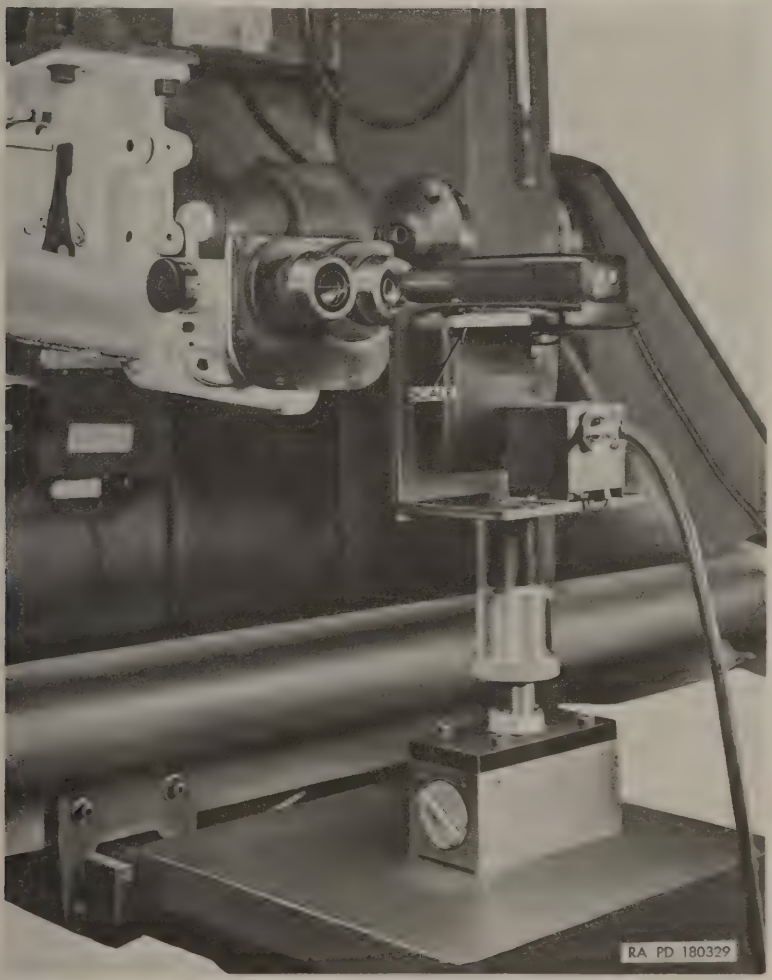


*Figure 347. Checking evenness of light transmission with visual telephotometer 7661575.*

*d.* Place the light source in front of the right end housing assembly, but leave the light source and the telephotometer plugged into the same outlet to eliminate volting error.

*e.* Mount the telephotometer in front of the right eyepiece as shown in figure 347.

*f.* Make three readings as in *c* above and subtract the average of these three readings from the average of the three readings obtained when reading directly from the light source.

*g.* Using the light transmission conversion chart (table IX), find the light transmission percentage.

*Table IX. Light Transmission Conversion Chart*

| Transmission to density | Percent | Transmission to density | Percent | Transmission to density | Percent |
|---|---|---|---|---|---|
| 1.0 | 10. 0 | 0.818 | 15. 2 | 0.695 | 20. 2 |
| 0.991 | 10. 2 | 0.813 | 15. 4 | 0.690 | 20. 4 |
| 0.983 | 10. 4 | 0.807 | 15. 6 | 0.686 | 20. 6 |
| 0.975 | 10. 6 | 0.801 | 15. 8 | 0.682 | 20. 8 |
| 0.967 | 10. 8 | 0.796 | 16. 0 | 0.678 | 21. 0 |
| 0.959 | 11. 0 | 0.791 | 16. 2 | 0.674 | 21. 2 |
| 0.951 | 11. 2 | 0.785 | 16. 4 | 0.670 | 21. 4 |
| 0.943 | 11. 4 | 0.780 | 16. 6 | 0.666 | 21. 6 |
| 0.936 | 11. 6 | 0.775 | 16. 8 | 0.662 | 21. 8 |
| 0.928 | 11. 8 | 0.770 | 17. 0 | 0.658 | 22. 0 |
| 0.921 | 12. 0 | 0.765 | 17. 2 | 0.654 | 22. 2 |
| 0.914 | 12. 2 | 0.760 | 17. 4 | 0.650 | 22. 4 |
| 0.907 | 12. 4 | 0.755 | 17. 6 | 0.646 | 22. 6 |
| 0.900 | 12. 6 | 0.750 | 17. 8 | 0.642 | 22. 8 |
| 0.893 | 12. 8 | 0.745 | 18. 0 | 0.638 | 23. 0 |
| 0.886 | 13. 0 | 0.740 | 18. 2 | 0.635 | 23. 2 |
| 0.879 | 13. 2 | 0.735 | 18. 4 | 0.631 | 23. 4 |
| 0.873 | 13. 4 | 0.731 | 18. 6 | 0.627 | 23. 6 |
| 0.867 | 13. 6 | 0.726 | 18. 8 | 0.623 | 23. 8 |
| 0.860 | 13. 8 | 0.721 | 19. 0 | 0.620 | 24. 0 |
| 0.854 | 14. 0 | 0.717 | 19. 2 | 0.616 | 24. 2 |
| 0.848 | 14. 2 | 0.712 | 19. 4 | 0.613 | 24. 4 |
| 0.842 | 14. 4 | 0.708 | 19. 6 | 0.609 | 24. 6 |
| 0.836 | 14. 6 | 0.703 | 19. 8 | 0.606 | 24. 8 |
| 0.830 | 14. 8 | 0.699 | 20. 0 | 0.602 | 25. 0 |
| 0.824 | 15. 0 | | | | |

*h.* Repeat these steps with the telephotometer in front of the left eyepiece and the light source in front of the left end housing assembly.

*i.* Determine the difference between the percentage of the right and left eyepieces.

*j.* Divide this difference by the higher of the determined percentages and the result is a percentage of the higher transmission.

*k.* If transmission is not within 20 percent of the higher transmission, check optics for smears, obstructions of free apertures, or check for the proper superimposition of the exit pupils in front of each eyelens.

*l.* To check evenness of illumination, turn the stereo switch to STEREO and compare the illumination of the stereo reticle in the left eyepiece to the stereo reticle in the right eyepiece. There should be no noticeable difference.

*m.* To correct unevenness, adjust either trimmer resistor on board assembly D7649117. See wiring diagrams (figs. 316 and 317).

## 409. Immersion Test

*a.* Remove the main bearing assemblies (pars. 95 and 96), the lower front control panel (par. 93), and the upper front control panel (par. 88).

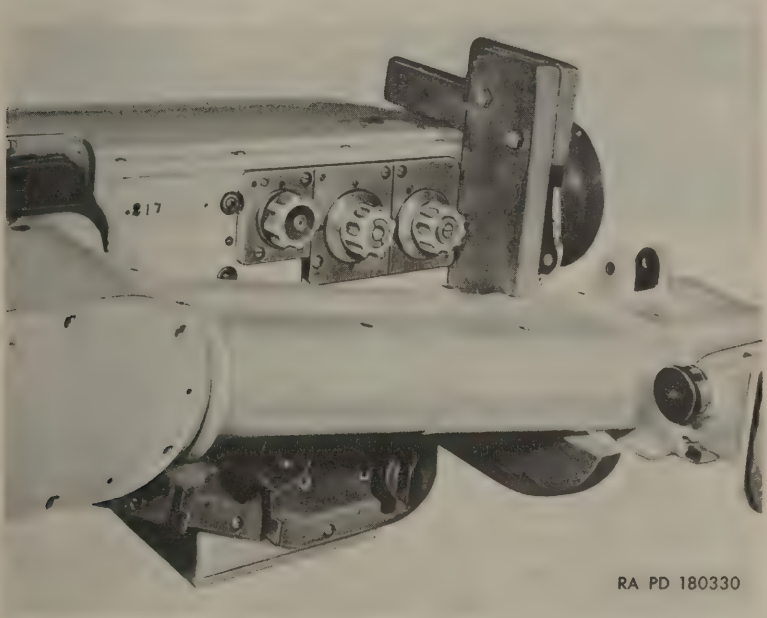


*Figure 348. Telescope cradle supporting telescope.*

*b.* To support the telescope, attach the improvised telescope cradle (figs. 42 and 43) as shown in figure 348.

*c.* Attach a pressure gage line to one cycle valve and an air pressure line to the other cycle valve (fig. 349).

*d.* Rig a rope sling as shown in figure 349 and lower the range finder into a tank of water until it is completely submerged.

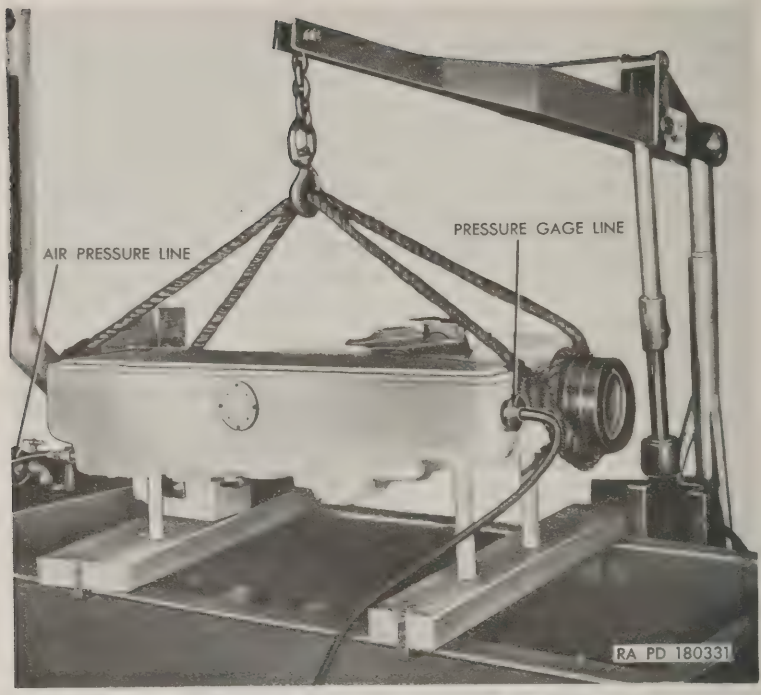


*Figure 349. Range finder in position for immersion test.*

*e.* Check for leaks under 3 pounds pressure. Rotate all knobs during immersion.

*f.* If leaks are found, reseat gaskets and reseal with noncuring sealing compound 52–C–3258–500 (par. 68). Use noncuring sealing compound 52–C–3258–505 (par. 69) around knobs and a locking compound on dowel pins.

## 410. Purging

*a.* Attach a hose from a nitrogen tank to the cycle valve in one end of the housing. Remove the valve stem from the cycle valve outlet in the other end of the housing.

*b.* Allow nitrogen to flow through the housing at 2 pounds per square inch pressure for 2 hours.

*c.* Replace the valve stem and the cycle valve caps.

## 411. Vibration Test

*a.* Attach the range finder to the vibration test instrument 7661921 (fig. 29) as shown in figure 350. Vibrate for 18 seconds.

*b.* After being subjected to the vibration test, the range finder should show no evidence of dirt when viewed through the eyepiece

or objective ends. If signs of dirt appear, the range finder must be disassembled and the pertinent part cleaned.

## 412. Condition of Optics

When looking through the eyepiece and objective ends, there must be no objectionable dirt, smears, scratches, digs, condensate, fungus growths, chips, fractures or cement separations. Bright spots (pin holes in reticles) are regarded as dirt. The shading or shadowing technique will be used to determine the presence of objectionable condensate or smears. "Shadowing" is the technique of looking into the eyepiece or objective ends obliquely so as to obtain reflections from a particular surface in the optical system. With this method, the surfaces of lenses and reticles are dark gray in appearance, and all defects (condensates, scratches, etc.) show up as white particles.

## 413. Tests Following Vibration Test

The tests and adjustments listed below are made after the vibration test (par. 411).

Divergence (par. 388).
Dipvergence (par. 389).
Image tilt (par. 390).
Parallelism of target images (par. 391).
Equality of magnification (par. 392).
Reticle alinement (par. 394*a* and *c*).

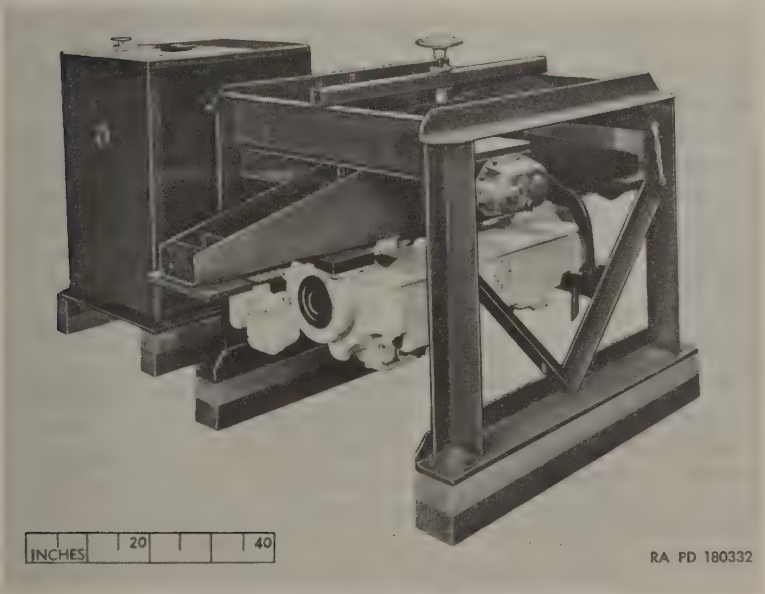


*Figure 350. Range finder in vibration test instrument.*

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Parallelism of sighting reticle and image (par. 394*b*).
Internal correction setting (par. 402).
Range accuracy (par. 404).

## Section IX. INSTALLATION OF RANGE FINDER ON THE TANK

### 414. Assembly of Range Finder to Turret Cover Plate

*a.* Using a hoist, attach the two short cables (fig. 70) to the front lifting eyes of the turret cover plate and the longer cable to the rear lifting eye. Carefully lower the plate to its proper position over the range finder (on the work bench) until it barely touches the range finder (fig. 71). In this position the keys of the range finder bearings will fit into the mating key-ways of the range finder mounting plate.

***Caution:*** Do not allow the plate to rest on the range finder as its weight may cause damage to the range finder.

*b.* Using the eight mounting screws, secure the range finder bearings to the mounting plate.

***Caution:*** Do not pull the bearings into place with the mounting screws.

*c.* Using the hoist, raise the turret cover plate and affixed range finder from the work bench. Remove the range finder mounting posts and store them in a suitable place as they will be needed when an unserviceable range finder is removed from a tank.

### 415. Installation of Turret Cover Plate and Affixed Range Finder in Tank Turret

*a.* Coat the turret cover plate seat (fig. 70) of the tank turret with adhesive sealing compound 52–C–3257–220 (par. 67).

*b.* Lower the cover turret plate, with affixed range finder, through the opening in the tank turret. It must be guided carefully to insure proper clearance of the eyepiece, cam box, and electrical receptacle as it passes through the turret top opening. The turret cover plate must fit into place evenly, and not be cocked or tilted. It must not be forced into place, but raised and lowered until it seats properly. Replace the 26 socket-head bolts (fig. 67) and fasten the plate securely in place, tightening the bolts evenly.

### 416. Installation of Range Finder End Housing Assemblies

*a.* Clean the exposed optics at each end of the range finder body and the end housing assemblies, using light strokes of a camel's hair brush. Remove accumulated dirt and dust from the brush by tapping it against a hard surface, away from the optics. Clean the main metal surface of the range finder and the end housing assemblies, using lint-free cloths. Position the end housing assemblies (figs. 22 and 69) in place, aline the keys with the key slots in the housing, and assemble six $\frac{5}{16}$ x $1\frac{1}{4}$ hex-head bolts and $\frac{5}{16}$-inch lock washers to each end hous-

ing, using finger tight pressure. Check to be sure that the end housing is seated firmly and does not rock on the mounting surface. Make certain that the wedge keys are loose in the key slots, using torque wrench 41–W–3628–125 (fig. 69), tighten the wedge key screws in the sequence listed in (1) through (5) below.

(1) Tighten the top wedge key screw to 10 inch-pounds of torque.
(2) Turn bottom wedge key screw to 20 inch-pounds.
(3) Turn top wedge key screw to 30 inch-pounds.
(4) Turn the bottom wedge key screw to 40 inch-pounds.
(5) Turn the top wedge key screw to 40 inch-pounds.

*b.* Tighten the six hex-head bolts on each end housing assembly in the order given.

### 417. Installation of Sealing Rings and Turret Caps

Check the movement and clearance of the range finder by elevating and depressing it manually. Press the four sealing ring halves (fig. 68) around the range finder end housing assemblies.

*Note.*—Be certain that the two halves of the end housing sealing ring are perfectly matched (i. e. the male and female joints of the inner felt ring match, and the chamfers of the outer steel surfaces match).

The chamfered surface is inserted first and the pressure applied evenly. Do not apply extreme force. Again check the movement of the range finder by elevating and depressing it manually. If there is a drag, the sealing ring has to be changed. Position the turret caps (fig. 67) and tighten the socket-head bolts evenly.

### 418. Installation of Ballistic Drive

Position the ballistic drive (K, fig. 65) to the mounting plate of the turret cover plate. Be sure that the top keys of the three bearings which support the ballistic drive are properly engaged with the mating recesses in the mounting plate. Holding them snugly against their mating surfaces, insert and tighten the ten mounting bolts evenly.

### 419. Installation of Body Assembly of Gunner's Periscope T35

Position the gunner's periscope T35 body assembly (M, fig. 66) alining it with the locating pins on the periscope mount. Hold the periscope body in position against the gunner's periscope mount (N, fig. 66) until the four holding screws (K, fig. 66) are inserted and tightened evenly.

### 420. Installation of Head Assembly of Gunner's Periscope T35

Position the periscope T35 head assembly (fig. 71), first carefully inserting it through the opening provided in the turret; then locating

it in position on the periscope mount by means of the locating pins. The bearing surfaces of the head assembly should fit properly without any rocking motion on the bearing surfaces of the periscope mount. Apply pressure at the center of the periscope mounting pad, while evenly tightening the two wing nuts.

*Note.*—Periscope heads must be properly held in position over the alining pins of the periscope mount to prevent damage to the friction bearing surfaces and slots of the periscope head. Nothing should obstruct the proper seating of the periscope head. Check for proper clearance in all corners of the turret or cupola openings. The periscope coupling (F, fig. 66) of the gunner's periscope mount (N, fig. 66) will be directly in line with the coupling of the ballistic drive and can easily be engaged with the aid of the elevation lever in the periscope coupling.

### 421. Installation of Gunner's Periscope Splash Plate

Lift the splash plate (G, fig. 66) and hold it in position against the gunner's periscope mount (N, fig. 66). Secure the splash plate to the mount by tightening the two serrated knobs (H, fig. 66).

### 422. Connection of Commander's Periscope T35 to Base Assembly of Ballistic Drive

Position the commander's periscope connector rod (E, fig. 66) to the base assembly of the ballistic drive and secure the two assemblies with the stud (R, fig. 66) through the connector by tightening the sockethead screws (Q, fig. 66) in the base assembly.

### 423. Connection of Range Finder to Ballistic Drive and Gun Trunnion, and Connection of Power Cables

*a.* Screw the connector rod (B, fig. 65) of the lower connector of the range finder into the ballistic drive connector (A, fig. 65).

*b.* Screw the connector rod of the range finder lower connector to the gun trunnion linkage.

*c.* Insert the power cable jack plug in the eight pin receptacle of the range finder and tighten the locking nut.

*d.* Plug the power cable from the tank's 24-volt dc source to the upper receptacle of the cover assembly of the ballistic drive (C, fig. 66). Plug in the power cable from the tank to the three prong receptacle in the base of the gunner's periscope mount.

### 424. Adjustment for the Installed Range Finder

*a.* Turn the master switch to the ON position.

*b.* Place the tank in a level position.

*c.* Check the gun travel with the gunner's quadrant M1; it must not exceed 10° depression and 20° elevation from a level position.

*d.* Turn the range knob (L, fig. 66) to "B," which is the bore sight position. This is the extreme clockwise position of the knob movement.

*e.* Turn the ballistic correction knob to "0."

*f.* Turn the ammo knob to "0."

*g.* Place a gunner's quadrant M1 across the two machined pads on the gun breech and level the gun.

*h.* Adjust the trunnion connector rod (F, fig. 65) from the gun trunnion to the range finder cam until the level bubble of the vial level on the range finder support is centered. This is "0" elevation position.

*i.* Tighten the cap screws on the upper connector.

*Note.*—Be sure the shaft of the connector is parallel to the gun trunnion and not in a cocked position.

*j.* Tighten the two lock nuts (J, fig. 65) on the linkage rod and check the level bubble on the ballistic cam support to be sure it remains centered.

*k.* Seal the lower connector and rod with the wire and seal which are furnished with the ballistic drive.

*l.* Rotate the range knob on the ballistic unit counterclockwise, until it stops, removing all superelevation from the periscopes. (Scales will read 0.)

*m.* Adjust the linkage from the ballistic drive to the range finder until the level bubble on the left of the ballistic drive unit is centered. Tighten the two lock nuts on the linkage rod and check the level vial again. Seal with wire provided.

*n.* Loosen the two lock nuts of the commander's periscope connector rod (E, fig. 66) and rotate the center rod of the linkage until the level vial bubble on the arm assembly of the commander's mount is centered. Secure the linkage by tightening the lock nuts and check the level vial again.

# CHAPTER 8
# FINAL INSPECTION

## 425. General

Final inspection is performed after repair and rebuild has been completed to insure that the range finder is serviceable according to established serviceability standards. It includes a general visual inspection for proper assembly of the range finder and a functional check to make sure that the equipment is in working condition and can function properly.

## 426. Inspection

*a. Completeness.* Examine the range finder carefully to be sure that all component parts are present. Particularly check for missing screws, pins, knobs, spare lamps, connectors, and nameplate.

*b. Appearance.* The appearance of the range finder will indicate its general condition and reflect the type of care and treatment it has received. Look for damaged, cracked or dented surfaces, bent or broken parts, moisture and/or corrosion on outside of range finder, and other evidence of damage or misuse which might indicate a need for repair.

*c. Sealing.* Inspect the sealed and painted portions of the range finder to determine whether sealing is complete.

*d. Condition of Optics.* When looking through the eyepiece and the objective ends of the range finder there will be no objectionable dirt, smears, scratches, digs, condensate, fungus growth, chips, fractures, or cement separations. Use the shading or shadowing technique (par. 412) to determine the presence of objectionable condensate or smears, when items are inspected after repair and rebuild.

*e. Eyepiece Focus.* The focus of the eyepiece for the sighting and ranging reticles shall be within $\pm 0.25$ diopter when the eyepiece diopter scale reads "0." For inspection procedure, see paragraph 385. The eyepiece shall be adjustable over the range of $\pm 3$ diopters, within 0.25 diopter, as read on the eyepiece scale. For inspection procedure, see paragraph 386.

*f. Definition.* The image will be sharp and clear at the center of the field. Definition will be checked with the aid of an auxiliary tele-

scope of at least three power focused at infinity. For inspection procedure, see paragraph 387.

*g. Magnification.* The magnification of the left and right systems shall be equal within ±1 percent. For inspection procedure, see paragraph 392.

*h. Image Tilt.* The images of a distant horizontal target line formed by the two optical systems shall be parallel within 20 minutes of arc and both images shall be horizontal within one degree with the level bubble centered from either direction. For inspection procedure, see paragraph 390.

*i. Internal Correction Setting.* When the ICS knob, calibrated in UOE's is moved from its mid point to any other graduation, the change in range (yds.) measured in UOE's must be equivalent to the corresponding change in the number of UOE's on the knob within ±15 percent. The scale of the ICS knob should be adjusted to read 25, ±5, for the average observer. For inspection procedure, see paragraph 402.

*j. Range Accuracy.* The range indicated on the range scale shall not differ from the true range by more than two UOE's (9.3 yds. at 1,000 yds.). For inspection procedure, see paragraph 404.

*k. Knob Travel.* All knobs shall have sufficient movement to cover the entire range of their corresponding scales.

*l. Bore Sight Knobs.* The bore sighting knobs will function without undue irregularities, friction or looseness when in an unlocked position. The knobs will be locked firmly when the locking levers are in the locked position.

*m. Parallax of Stereoscopic Reticle.* The change in the vertical and horizontal positions of the observer's eyes to the extremes of the exit pupil shall not cause more than three UOE medium range in error from the reading in the center of the exit pupils in the apparent relative distance of the target marks when ranging on a target at 1,500 ±200 yards distant, both with and without the filters. Increasing the IPD setting by 2 mm shall not cause more than two UOE's medium ranging error in the apparent relative distance of the target marks when ranging on the above target both with and without the filters. For inspection procedure, see paragraph 399.

*n. Parallax of Sighting Reticle.* Provide a target of 1,500 ±200 yards and set the range scale to agree with the range chosen. Parallax in the right and left optical systems at the optical axis (bore sight mark) shall not exceed 0.1 mil (width of reticle line). For inspection procedure, see paragraph 397.

*o. Illumination.* When illuminated, the scales will respond as indicated on the nameplate, the brightness will be controlled by the rheostat knob.

*p. Lubrication.* The range finder will be lubricated with aircraft and instruments grease at time of repair and rebuild.

*q. Painting.* Paint will be in good condition and neither chipped nor cracked. The paint will afford protection against corrosion and the range finder will present an appearance similar to that of a new instrument.

*r. Optical Coating.* Range finders which are processed through an ordnance base maintenance shop on a "repair and rebuild" basis will have coated optics in accordance with TM 9–1501.

# CHAPTER 9

# SHIPMENT AND STORAGE

## 427. Shipping Instructions

*a. Domestic Shipping Instructions.*

(1) *Preparation.* When shipping range finders interstate or within the continental United States, the officer in charge of preparing the shipment *will be responsible* for furnishing range finders to the carriers for transport in a *serviceable* condition, properly packaged and packed (par. 429).

*Note.*—Personnel withdrawing range finders from limited storage for domestic shipment must not open boxes that have been previously inspected and packed. If it is determined that the Method II Pack has been damaged or broken, inspect range finders to insure that they are complete and serviceable and then process, package, and pack in accordance with paragraph 429.

(2) *Army shipping documents.* Prepare all Army shipping documents accompanying freight in accordance with TM 38–705.

*b. Oversea Shipping Instructions.*

(1) *Inspection.* Inspect range finders destined for oversea use, prior to shipment, to determine their completeness and serviceability. Replace defective range finders.

*Note.*—Normally it is not necessary to inspect range finders in sealed packages since they have been inspected for serviceability prior to packaging and during storage.

(2) *Preparation for shipment to ports.* Prepare range finders destined to ports of embarkation for oversea shipment in the same manner as prescribed for domestic shipment (*a* above).

## 428. Storage Instructions

*a. Limited-Storage Instructions.*

(1) *Receiving inspections.*

(*a*) Report on DD Form 6 (Report of Damage or Improper Shipment) all range finders received in a damaged condition or improperly prepared for shipment, in accordance with SR 745–45–5. Report of range finders received in

an unsatisfactory condition (chronic failure or malfunction) will be made on DA Form 468, in accordance with SR 700–45–5.

(*b*) Immediately upon receipt, for storage, range finders that have not been inspected and prepared for limited storage, will be given a limited technical inspection and processed, packaged, and packed as prescribed in paragraph 429. The results and classification will be recorded and packed with the range finders.

(*c*) Perform a systematic inspection and replace or repair all missing or broken parts. If repairs are beyond the scope of the unit, causing the range finders to be out of service for an appreciable length of time, place them in a limited-storage status and attach a tag specifying the repairs needed. The report of these conditions will be submitted by the unit commander for action by an ordnance maintenance unit.

(2) *Inspection during storage.* Perform a visual inspection periodically to determine general condition.

(3) *Storage site.*

(*a*) Personnel must carefully note the storage location to determine whether the location is adequate for the range finders.

(*b*) Store all range finders in a room having a low relative humidity (40% or less) and at an even temperature, whenever possible. Where it is found necessary to store range finders outdoors, cover and protect them against the elements as prescribed in TB ORD 379.

(4) *Removal from limited storage.*

(*a*) If the range finders are not shipped or issued upon expiration of the limited-storage period, they must be further treated for stand-by or long-term storage as prescribed in *b* below.

(*b*) If the range finders to be shipped will reach their destination within the limited-storage period, they need not be reprocessed upon removal from storage, unless inspection reveals it to be necessary according to anticipated in-transit weather conditions.

(*c*) Range finders will be serviced in accordance with paragraphs 41 and 42, when it has been ascertained that they are to be placed into immediate service.

(*d*) Repair and/or replace all range finders tagged in accordance with (1) (*c*) above.

*b. Stand-By and Long-Term Storage.*

(1) *Maintenance in-storage inspection.*

(*a*) Maintenance in-storage inspection must be performed by qualified ordnance maintenance personnel.

(*b*) Inspection of range finders will preferably be performed in an area expressly set aside for that purpose or in a maintenance shop, when such facilities are available at the installation.

(*c*) Inspect at least 1 percent of the range finders in storage semiannually. If results of the 1 percent inspection reveal defective range finders, then inspect 10 percent of the range finders. If additional defective range finders are discovered, then inspect the entire lot, place in a serviceable condition and process, package, and pack in accordance with paragraph 429.

(*d*) When a 1 percent or 10 percent inspection proves satisfactory, select range finders not previously inspected for the next inspection.

*Note.*—Materiel must not be removed from Method II Pack for percentage inspection. However, a visual inspection should be made and, if the Method II Pack has been damaged or broken materiel must be removed and processed, packaged, and packed as prescribed in paragraph 429.

(2) *Packaging.* Inspectors must carefully examine selected range finders, observing the basic points listed in (*a*) through (*c*) below.

(*a*) Condition of containers.

(*b*) Legibility and *accuracy* of package markings.

(*c*) Method of packaging.

## 429. Processing, Packaging, and Packing

*a. Disassembly* (figs. 351 and 352). Remove the left and right end housing from the main housing assembly as directed in paragraph 72.

*b. Cleaning.* Clean the exterior surfaces in accordance with cleaning method C–4 "petroleum solvent applied by scrubbing or wiping" (see TM 38–230), in a manner that will remove dirt, smudges, fingerprints and any foreign substances. Clean optics on each instrument with lens tissue.

*c. Packaging.*

(1) Cover all windows or optics with at least four thicknesses of neutral lens-tissue and secure in place with water resistant pressure-sensitive adhesive tape. Cover the lens tissue with cellulosic cushioning material and secure in place with pressure sensitive tape.

(2) Place greaseproof barrier-material grade A over open end of each end housing and main housing and apply a plywood cover held in place with bolts (fig. 352 and detail F, and fig. 354).

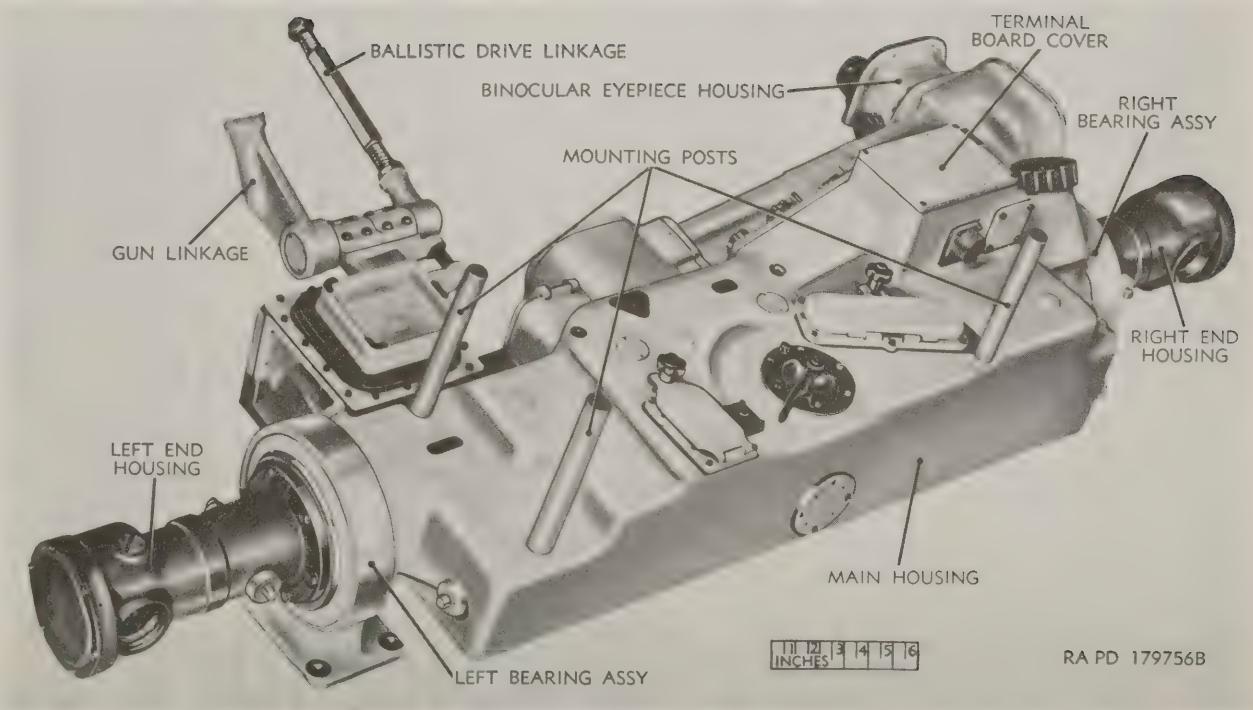


***Figure 351. Range finder—bottom view.***

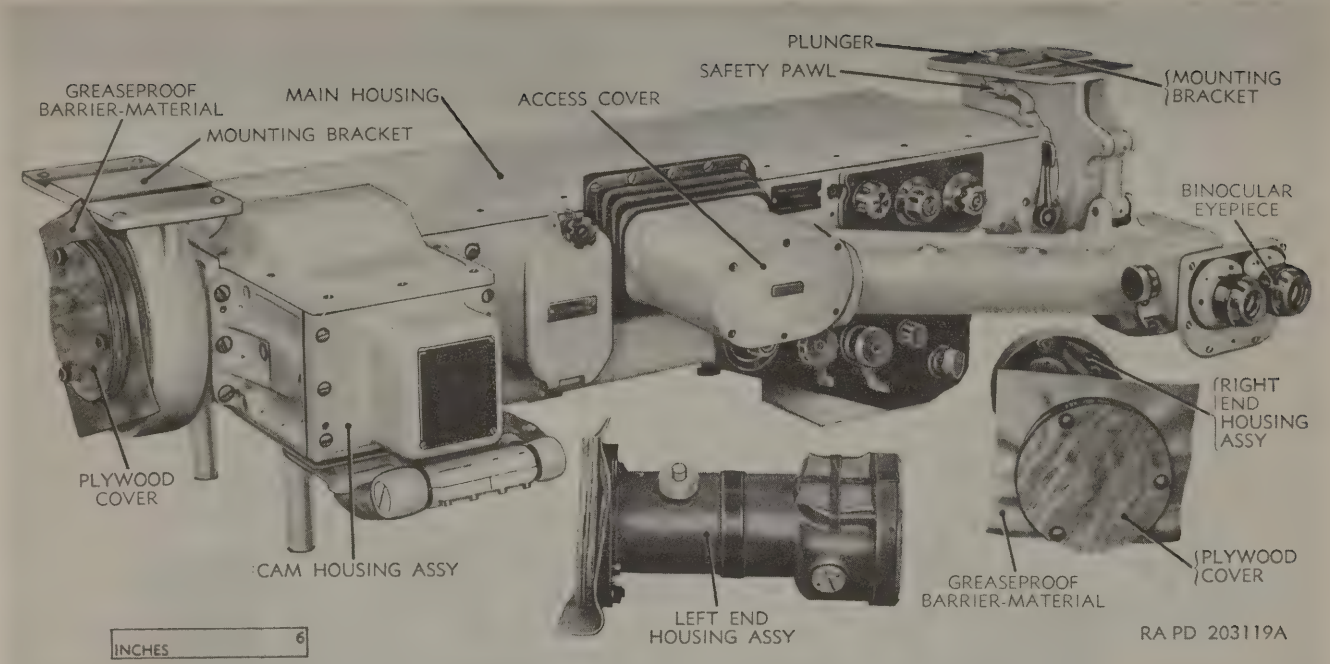


*Figure 352. Range finder—disassembled for packaging.*

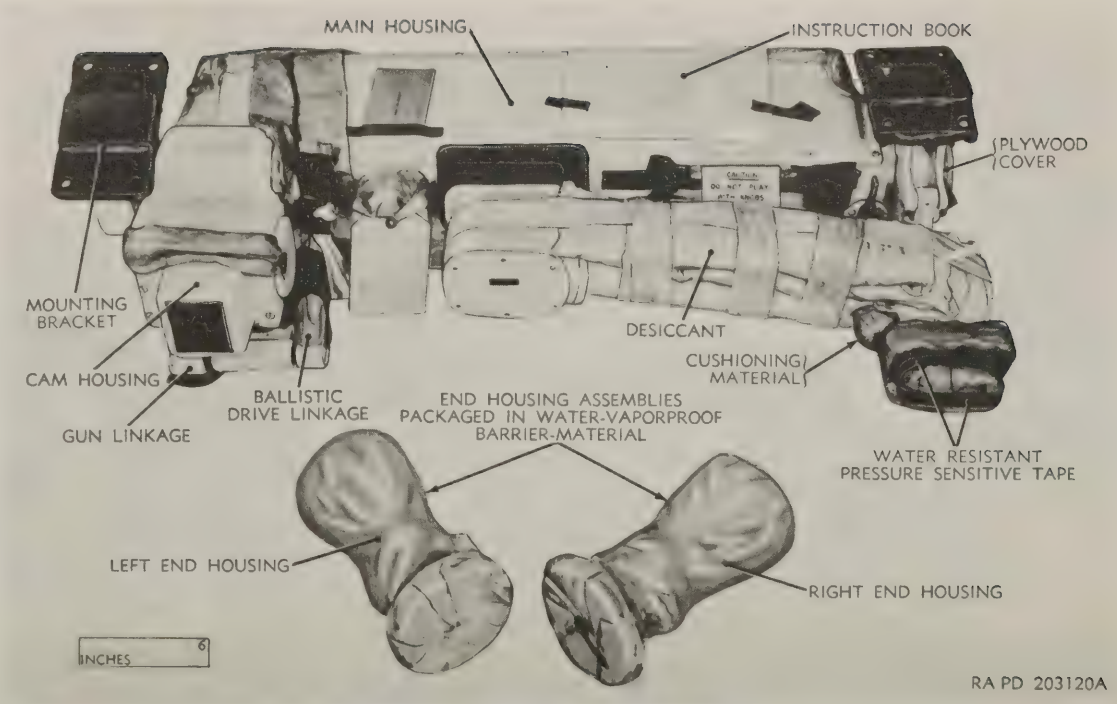


***Figure 353. Range finder partially packaged.***

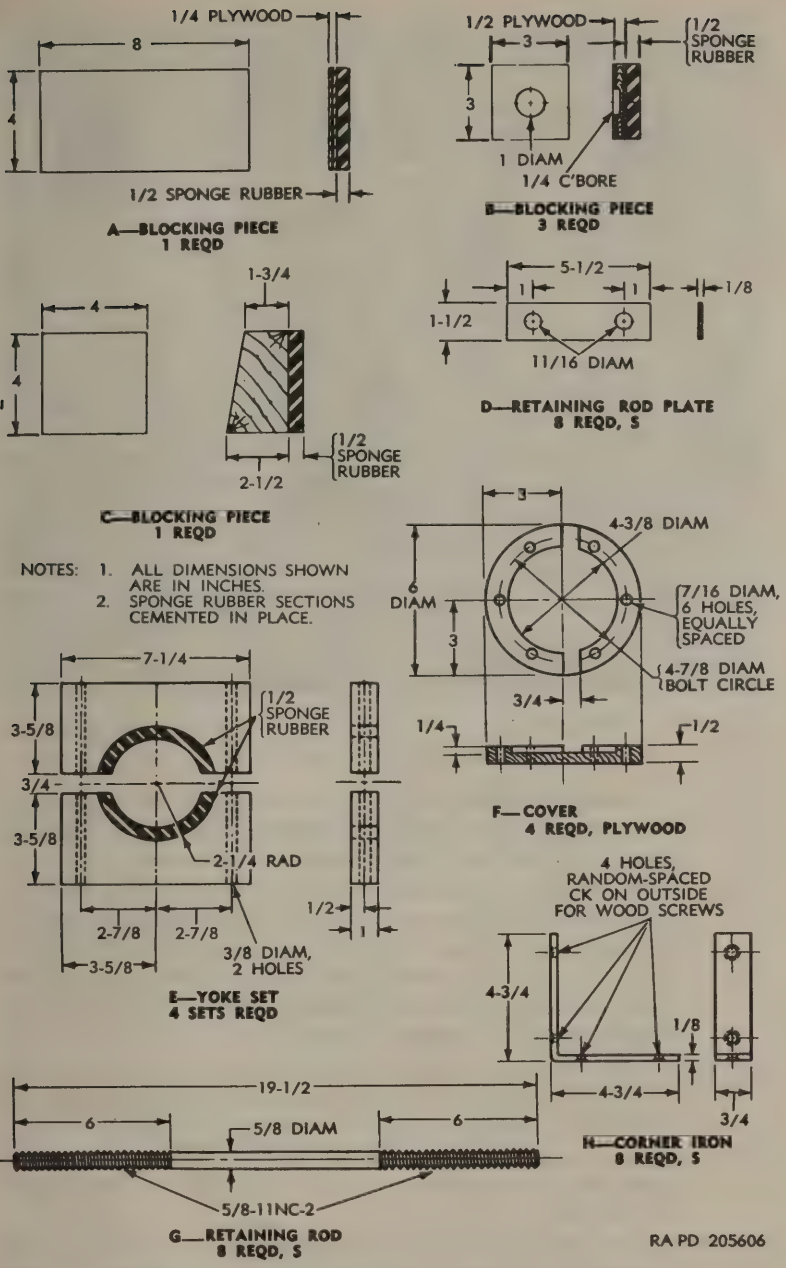


*Figure 354. Construction details of blocking components.*

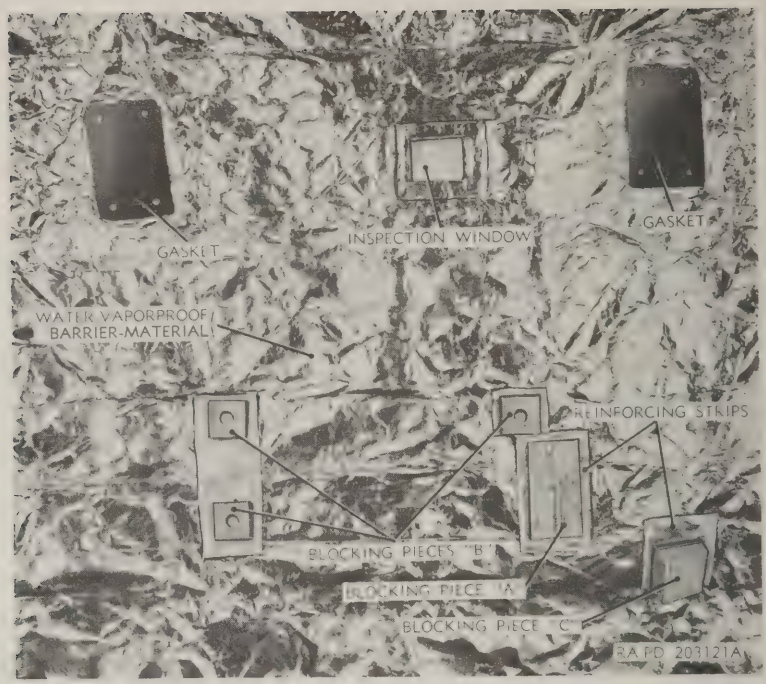


*Figure 355. Arrangement of wood blocks, gaskets, and inspection window on water vaporproof barrier-material.*

***Caution:*** The critically finished mating surfaces of the end housing and main housing assemblies must not be scratched, marred or damaged in any manner whatsoever.

(3) Wrap each end housing assembly with cellulosic cushioning material and secure with water resistant pressure-sensitive adhesive tape. Place each end housing, with proper amount of desiccant, into a water-vaporproof barrier bag of suitable size, exhaust entrapped air and heat seal. Apply Method II labels and marking labels (fig. 351).

*Note.*—To determine quantities of desiccant required, see TM 38-230. Separate bags of desiccant from metal surfaces by adequate barrier-material.

(4) Close level-vial cover and secure in place with pressure sensitive tape to prevent the metal cover from rotating from vibration.

(5) Cover threaded portions of ballistic drive linkage with greaseproof barrier-material, grade A. Cover entire linkage with cellulosic cushioning material, and secure with pressure sensitive tape. Rotate linkage upward until it rests against

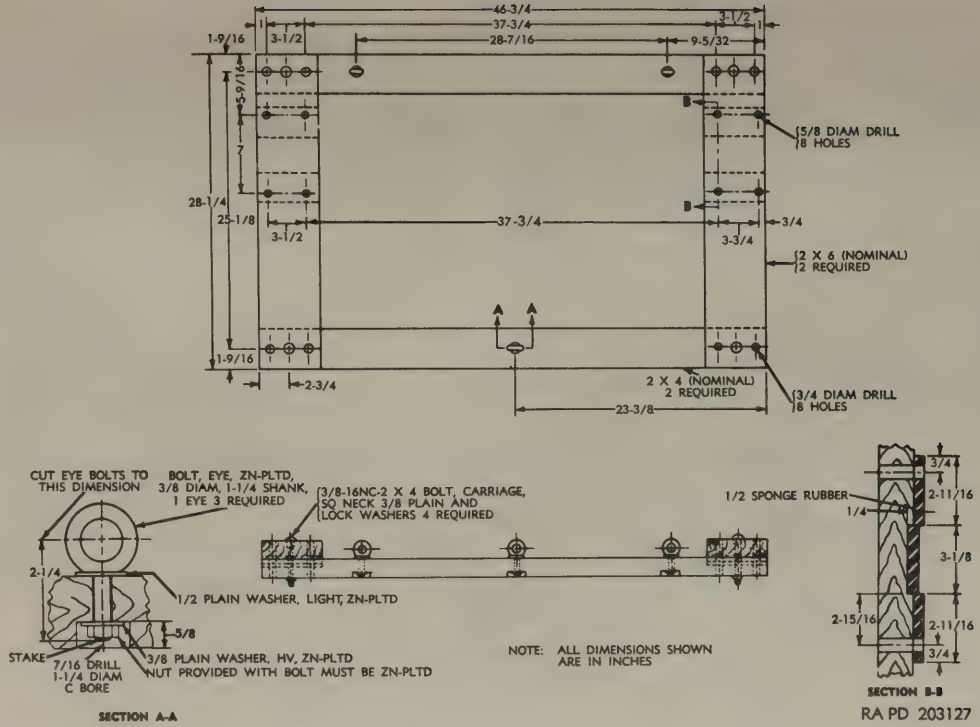


*Figure 356. Construction details of cradle.*

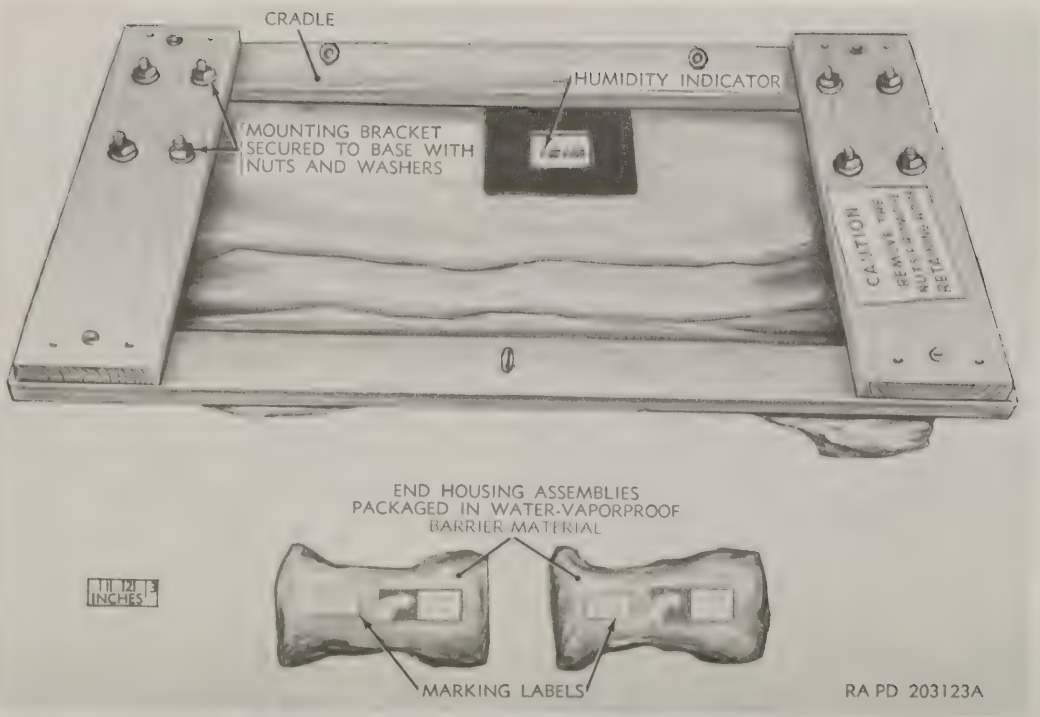


*Figure 357. Packaged range finder bolted to cradle.*

upper cover of main housing. Cover the gun linkage with cellulosic cushioning material and secure with pressure sensitive tape. Rotate the linkage under until it contacts the base of the cam housing. Secure the ballistic drive linkage to the gun linkage in this position with a wire. Place cellulosic cushioning material under wire where it contacts main housing and secure with pressure sensitive tape. Draw wire taut.

(6) Place flexible, single-face, corrugated fiberboard over all the knobs and secure with pressure sensitive tape.

(7) Cover binocular eyepieces with cellulosic cushioning material, and secure with pressure sensitive tape.

(8) Cover all projections and sharp corners on main housing with cellulosic cushioning material and secure with pressure sensitive tape as shown in figure 353.

(9) Wrap hardware in greaseproof barrier material, grade A. Overwrap in flexible, single-face corrugated fiberboard, and secure to the main housing with pressure sensitive tape. Attach a tag to the main housing, reading, "CAUTION: DO NOT PLAY WITH KNOBS."

(10) Place the main housing on a sheet of water-vaporproof barrier-material and mark the locations of the three mounting posts, terminal board cover, and the bottom of the telescope housing between the binocular eyepiece housing and the right bearing (fig. 351). Construct blocking pieces, "A," "B," and "C," as shown in figure 354. Cut reinforcing strips of water-vaporproof barrier material slightly larger than the blocking pieces and heat-seal them as shown in figure 355. Carefully mark the locations again on the strips and cement the blocking pieces "A" and "C" to the strips, as shown in figure 355. Do not cement the three blocking pieces "B."

(11) Place an inspection window in the barrier material, above the blocking pieces, as shown in figure 355.

(12) Position the main housing on the blocking pieces.

(13) Attach a humidity indicator to the range finder with pressure sensitive tape in such a position that it will be visible through the window when the barrier-material is installed.

(14) Attach bags of desiccant to the main housing, as far away from the humidity indicator as is possible.

*Note.*—To determine the amount of desiccant required see TM 38–230. Separate bags of desiccant from metal surfaces by adequate barrier-material.

(15) Cut two gaskets, figure 355, conforming with bolt holes and dimensions of mounting brackets of main housing. Position and heat seal the gaskets to the vaporproof barrier-material,

making sure that the gaskets will aline with the mounting brackets when the barrier-material is finally installed. Punch holes through gasket bolt holes and barrier material.

(16) Form the barrier material over the main housing so holes aline with the bolt holes in the mounting brackets.

(17) Construct a cradle for the wrapped range finder as shown in figure 356.

*Note.*—Rubber pads should be cemented to the base.

Attach the base to the mounting brackets with ½ x 3-inch bolts with plain and lock washers and nuts, shown in figure 357. Place plain washers on bolts before sliding them up through mounting brackets and plain and place lock washers under the nuts.

*Note.*—Do not tighten the nuts over the mounting bracket with the plunger.

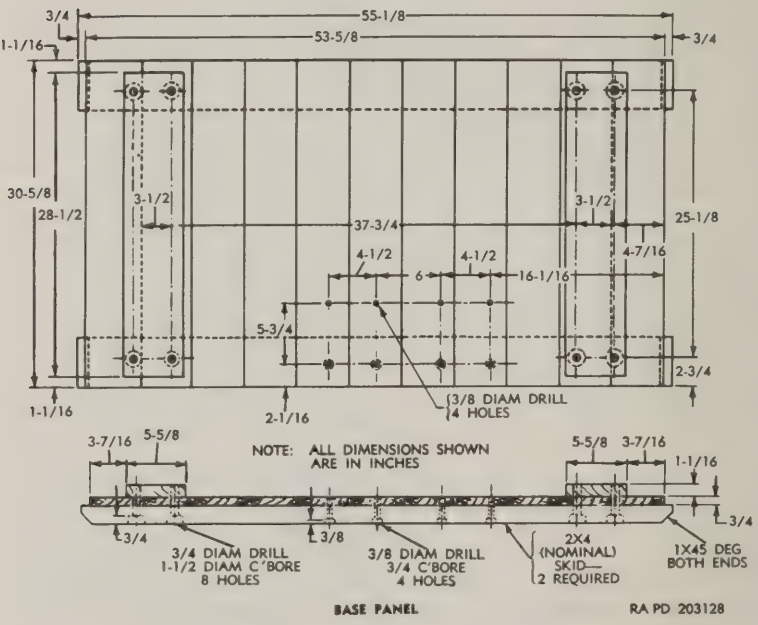


*Figure 358. Construction details of skid base.*

(18) Heat-seal all seams except an opening for tightening the nuts (*d*(3) below).

*d. Packing.*

(1) Construct a skid base as shown in figure 358.

(2) Fabricate the retaining rod plates "D," yokes "E," retaining rods "G," and corner irons "H" as shown in figure 354. As-

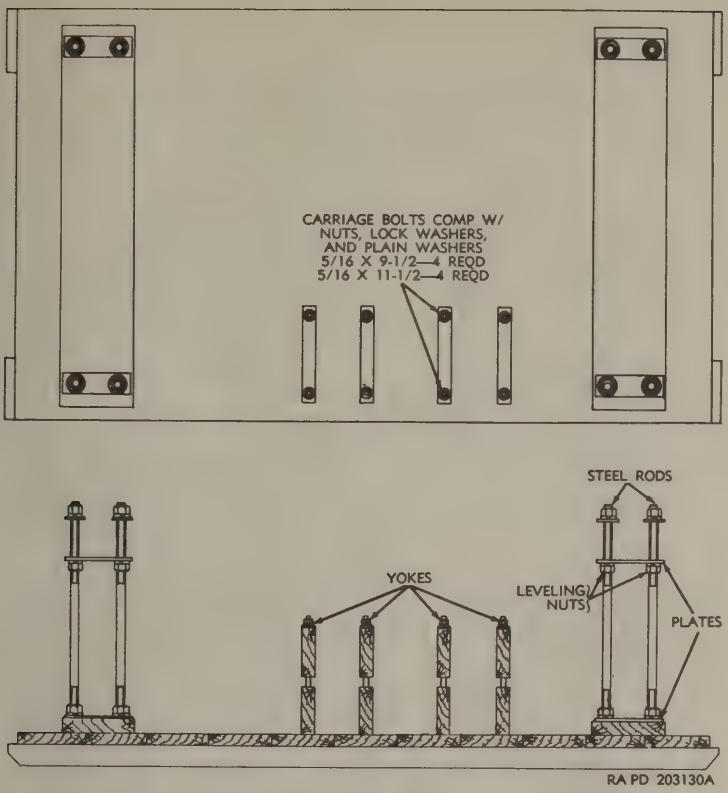


*Figure 359. Location of steel rods, yokes, and plates on skid base.*

semble these components to the skid base panel as shown in figure 359.

(3) Place the cradle, with packaged main housing attached, on the retaining rods. Tighten the nuts over the mounting bracket with the plunger until the safety pawl (fig. 352) is disengaged. Raise or lower the cradle with main housing by means of the leveling nuts until the weight is evenly distributed on the blocking pieces and retaining rods. Exhaust the air with a vacuum pump and heat-seal the remaining opening. Apply identification and "Method II Pack" labels.

(4) Secure the packaged end-housings in the yokes (fig. 361).

(5) Apply unthinned paint on all threads in back of nuts to prevent loosening.

(6) Construct top, side, and end panels as shown in figure 360. Assemble the end and side panels, as shown in figure 361.

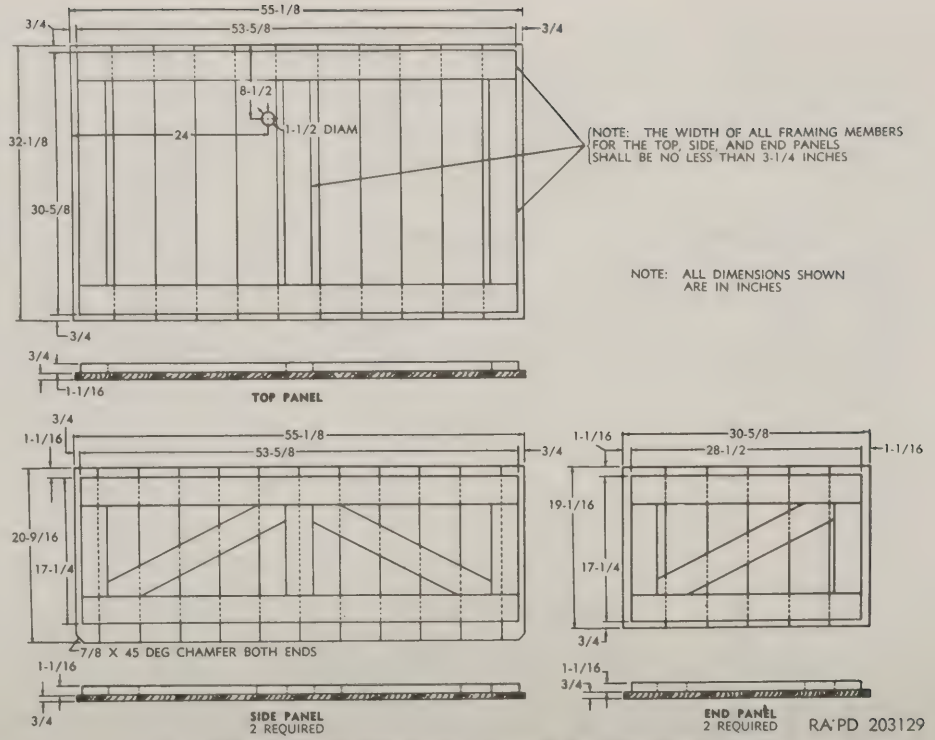


*Figure 360. Construction details of top, side, and end panels.*

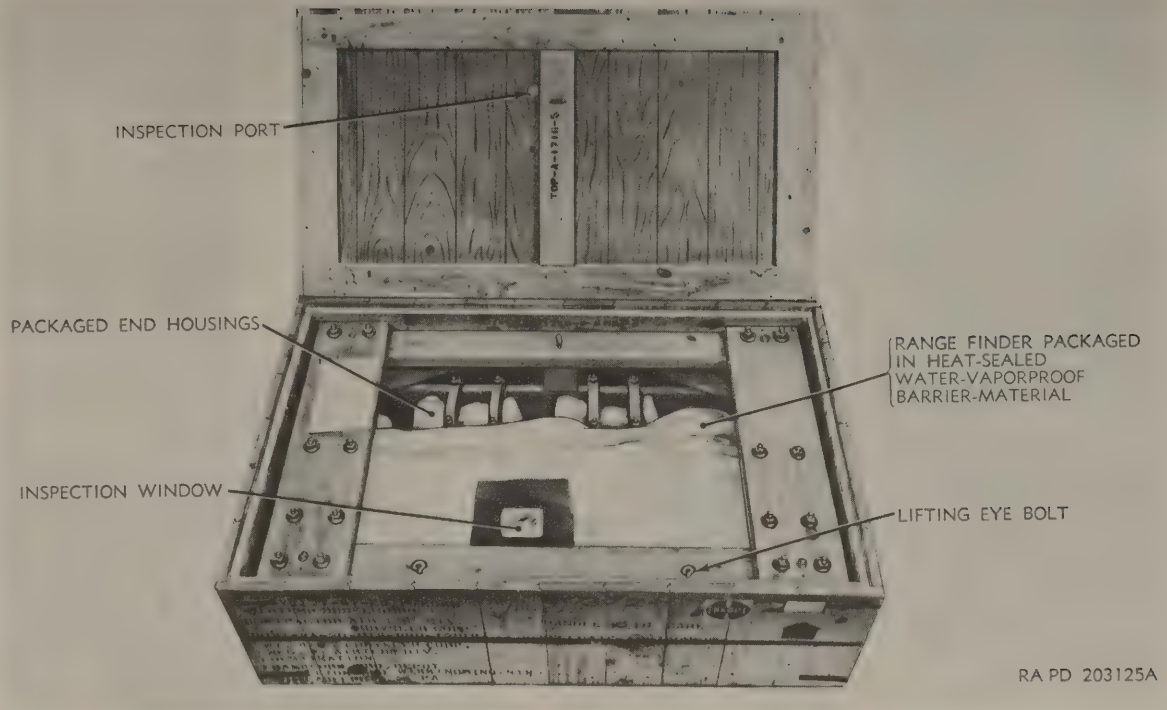


*Figure 361. Completed pack of range finder.*

(7) Attach a tag to the transverse member of the cradle, with the following instructions: CAUTION: REMOVE THE NUTS FROM THE RETAINING RODS. Loosen the nuts on the bolts which secure this transverse member to the mounting bracket to a point where the pawl plunger is free. Rotate the main housing slightly until the pawl is engaged. The main housing can be removed safely from the box when the pawl is engaged.

(8) Nail the top panel in place and apply strapping, corner irons and corner straps (see TM 9–2854). Inspection port in top cover should be cut and positioned in a manner that will insure a clear view of the humidity indicator inside the interior floating bag (figs. 360 and 361). Supply a suitable removable-type cover for the port and mark: "Inspection Port."

## 430. Marking

*a. Domestic.*

(1) The following information will appear on exterior container.
- (*a*) Stock number.
- (*b*) Nomenclature.
- (*c*) Quantity and unit of issue.
- (*d*) Date packed.
- (*e*) Installation.
- (*f*) Method of preservation.
- (*g*) Serial number (when applicable).
- (*h*) Inspector's number.
- (*i*) Weight.
- (*j*) Precautionary markings to include "Method II Pack" label, fragile label, and indicate center of balance.

(2) Shipping markings will include information as outlined in (*a*) through (*c*) below.
- (*a*) Package number.
- (*b*) Voucher number.
- (*c*) Domestic address label.

*b. Oversea.* For shipment to ports of embarkation for oversea destination the containers will be marked as prescribed for domestic shipment *a*(2) above, and in addition, will include the following (see SR 746–30–5).

(1) Oversea address.

(2) SNL group number applied adjacent to service color corner marking.

(3) Requisition number.

(4) Service color marking.

(5) Cube.

(6) Ordnance symbol (yellow flaming bomb applied adjacent to oversea address).

(7) Special markings and caution labels when applicable (see TM 9–2854).

*c. Protection of Markings (Domestic and Oversea).* Markings shall be protected by a coating of transparent waterproof protective lacquer, adhesive cement or clear spar varnish.

*Note.*—Containers with items of a pilferable nature such as binoculars, compasses, etc., will not show the nomenclature in the markings of the exterior shipping container on either domestic or oversea shipments.

*d. Loading and Blocking.* For general loading rules and methods and procedures for loading and blocking boxed materiel, see TM 9–2854.

# APPENDIX

# REFERENCES

## 1. Publication Indexes

Special regulations in the 310–20-series; DA Pam 108–1; ORD 1, and FM 21–8 should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to materiel covered in this manual.

## 2. Supply Manuals

The following manuals of the Department of the Army Supply Manual pertain to this materiel:

*a. Destruction To Prevent Enemy Use.*

Land Mines and Components; Demolition Explosives and Related Items; and Ammunition for Simulated Artillery, Bobby Trap, Hand Grenade, and Land Mine Fire---------- ORD 3 SNL R–7

*b. Repair and Rebuild.*

Cleaners, Preservatives, Lubricants, Recoil Fluids, Special Oils, and Related Maintenance Materials---------- ORD 3 SNL K–1
Items of Soldering, Metalizing, Brazing, and Welding Materials; Gases and Related Items---------- ORD 3 SNL K–2
Lubricating Equipment, Accessories, and Related Dispensers---------- ORD (*) SNL K–3
Lubricating Fittings, Oil Filters, and Oil Filters Elements--- ORD 5 SNL H–16
Major Items and Major Combinations of Group F---------- ORD 3 SNL F–1
Miscellaneous Hardware---------- ORD 5 SNL H–2
Standard Hardware---------- ORD 5 SNL H–1
Tool Set, Fire Control Repairman---------- ORD 6 SNL J–10, Section 13
Tool Set, Instrument Repairman (MOS 3922)----- ORD 6 SNL J–10, Section 14
Special Tool Sets for Sighting and Fire Control Materiel Used with Small Arms, Automatic Guns, Mortars, and Field Artillery---------- ORD 6 SNL J–32

*c. Sighting and Fire Control Equipment.*

Finder, Range, M12 and T41---------- ORD (*) SNL F–356, Section 1

*See SR 310–20–9, Index of Supply Manuals—Ordnance Corps, for published manuals of the Ordnance section of the Department of the Army supply manual.

## 3. Forms

DA Form 9–71, Locator and Inventory Control Card.
DA Form 9–72, Ordnance Stock Record Card.
DA Form 9–76, Request for Work Order.
DA Form 9–77, Job Order Register.
DA Form 9–78, Job Order.
DA Form 9–79, Parts Requisition.
DA Form 9–80, Job Order File.
DA Form 9–81, Exchange Part or Unit Identification Tag.
DA Form 446, Issue Slip.
DA Form 447, Turn-in-Slip.
DA Form 468, Unsatisfactory Equipment Report.
DA Form 811, Work Request and Job Order.
DA Form 811–1, Work Request and Hand Receipt.
DA Form 828, Job Time Ticket—Individual.
DA Form 829, Rejective Memorandum.
DA Form 865, Work Order.
DA Form 866, Consolidation of Parts.
DA Form 867, Status of Modification Work Order.
DD Form 6, Report of Damaged or Improper Shipment.

## 4. Other Publications

The following explanatory publications contain information pertinent to this materiel and associated equipment:

*a. Camouflage.*

Camouflage, Basic Principles ..... FM 5–20

*b. Decontamination.*

Decontamination ..... TM 3–220
Defense Against Chemical Attack ..... FM 21–40

*c. Destruction To Prevent Enemy Use.*

Explosives and Demolitions ..... FM 5–25
Ordnance Service in the Field ..... FM 9–5

*d. General.*

Inspection of Ordnance Materiel in the Hands of Troops ..... TM 9–1100
Accident Reporting ..... SR 385–10–40
Standard Artillery and Fire Control Materiel ..... TM 9–2300
Unsatisfactory Equipment Report ..... SR 700–45–5

*e. Operation.*

Tank, gun, 90-mm, M47 ..... TM 9–718A

*f. Repair and Rebuild.*

Abrasive, Cleaning, Preserving, Sealing, Adhesive and Related Materials Issued for Ordnance Materiel ..... TM 9–850
Fire Control Materiel: Lubrication ..... TB 9–2835–1

Hand, Measuring, and Power Tools ..... TM 10–590
Instruction Guide: Instrument Repairman ..... TM 9–2602
Lubrication ..... TM 9–2835
Maintenance and Care of Hand Tools ..... TM 9–867
Maintenance Responsibilities and Shop Operation ..... AR 750–5
Modification of Ordnance Materiel ..... SB 9–38
Ordnance Maintenance and General Supply in the Field ..... FM 9–10
Painting Instructions for Field Use ..... TM 9–2851

*g. Shipment and Stand-By and Long-Term Storage.*

Army Shipping Document ..... TM 38–705
Instruction Guide: Ordnance Packaging and Shipping (Posts, Camps, and Stations) ..... TM 9–2854
Marking of Oversea Supply ..... SR 746–30–5
Military Standard—Marking of Shipments ..... MIL–STD–129**
Ordnance Storage and Shipment Chart—Group F ..... SB 9–OSSC–F
Processing of Unboxed and Uncrated Equipment for Oversea Shipment ..... AR 747–30
Preservation, Packaging, and Packing of Military Supplies and Equipment ..... TM 38–230
Processing of Motor Vehicles and Related Unboxed Materiel for Shipment and Storage ..... SB 9–4
Protection of Ordnance General Supplies in Open Storage ..... TB ORD 379
Report of Damaged and Improper Shipment ..... SR 745–45–5
Standards for Oversea Shipment and Domestic Issue of Ordnance Materiel Other than Ammunition and Army Aircraft ..... TB ORD 385

**Copies may be obtained from Aberdeen Proving Ground, Aberdeen, Md.

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